FACULTY PERCEPTIONS OF FORMATIVE ASSESSMENT AND IMPLEMENTATION PRACTICES IN PRE-CLINICAL MEDICAL EDCUATION: A Q METHOD STUDY

By

BRANDY CLOSE

Bachelor of Science in Exercise Physiology
Texas Christian University
Fort Worth, TX
1996

Master of Education
Texas Christian University
Fort Worth, TX
2002

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF PHILOSOPHY
May, 2017

FACULTY PERCEPTIONS OF FORMATIVE ASSESSMENT AND IMPLEMENTATION PRACTICES IN PRE-CLINICAL MEDICAL EDCUATION: A Q METHOD STUDY

Dissertation Approved:

Penny Thompson, Ph.D

Dissertation Adviser

Susan Stansberry, Ph.D.

Steve Marks, Ph.D.

Matt Vassar, Ph.D.

ACKNOWLEDGEMENTS

This has definitely been a journey for not only me, but for those closest to me. I reach this destination in large part due to the endless patience, encouragement, and support of friends, family, and coworkers. I wish to thank all of those at OSU-CHS that showed constant support and encouragement, which kept me working toward this goal. I would like to thank 'work Dan' and Val for their relentless support and genuine excitement for my success. I look forward to many years of fun and success with you all by my side.

To my committee members – I sincerely thank you. Dr. Penny Thompson, thank you for your patience and guidance, which kept me on course. Dr. Susan Stansberry, thank you for always believing in me and for making sure I never gave up. Dr. Steve Marks, thank you for your support and the amazing opportunities with NASA Education that started this journey. Dr. Matt Vassar, thank you for being my invaluable resource – your encouragement and ability to keep me laughing was worth more than you know.

A sincere and heartfelt thank you belongs to my parents, my sisters, and Dan Close. Mom and dad, thank you for all you have done that allowed this journey to become a reality. Your support in so many ways made this possible. Mel and Kim, thank you for your love, support, and encouragement. I am incredibly lucky to have you both constantly rooting for me. Dan, I owe you a tremendous amount of thanks for your constant support and willingness to be there for Max during my endless hours in the library.

Lastly, the greatest thank you belongs to my son. Max, you have endured this journey with me like a champion. You have been so patient and understanding throughout this entire journey. You were my rock, a constant voice of encouragement, and my biggest supporter. You are the reason I persevere. I love you to infinity and beyond.

Name: BRANDY CLOSE

Date of Degree: MAY 2017

Title of Study: FACULTY PERCEPTIONS OF FORMATIVE ASSESSMENT AND IMPLEMENTATION PRACTICES: A Q METHOD STUDY

Major Field: EDUCATIONAL TECHNOLOGY

Abstract: This study describes faculty perceptions of formative assessment and the influence their perceptions have on implementation practices. Assessment is often misunderstood and too often becomes an afterthought in the teaching process. Measuring curricular success by overall student outcomes means instructional and assessment methods have a relationship with summative outcomes. Faculty perception of the use or importance of formative assessment influences their use of formative assessment within the instructional process. A review of the literature in formative assessment, educational technology, and implementation practices is presented. The review as well as the researcher's personal experience as an instructional designer with which the participants work was used to develop a set of 36 statements that were sorted by 20 faculty using Q methodology protocol. A four-factor solution was the result of an analysis using PQMethod software. Themes for the resulting factors were interpreted using a demographic questionnaire, survey and interview data. The four factors were interpreted as Confident Users, who felt knowledgeable about formative assessment and were confident in their use; Unfamiliar Supporters, who felt very uninformed about formative assessments, but assumed they were useful; Purposeful User, who felt confident and purposeful about understanding and implementing formative assessment; and Cautious Users, who felt knowledgeable about formative assessments, but have had prior experiences that influence their use. Conclusions include: the majority of the faculty perceive formative assessment as useful to the learning process, about half of the faculty care to use educational technology to implement formative assessments, several faculty feel that planning and implementing formative assessments place additional time and effort constraints on their teaching processes, and most of the faculty who use formative assessments are not confident in how to use the feedback to improve teaching methods and learning outcomes. Future research should study how faculty use educational technology to implement formative assessments and indicate why its implementation improved student outcomes. Future research should also study how faculty perceive formative assessments' role in increasing student engagement. The findings of this study identified the need for well-developed and well-implemented faculty development programs in order to support better understanding and implementation practices of formative assessment.

TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

CHAPTER I

INTRODUCTION

Curriculum, instruction, and assessment are the three fundamental components of an education system that, regardless of the educational platform, must be equally strong in order for the system to function properly (Orlando, 2011). In my experience as an instructional designer at a medical school, I often observe faculty struggling with how to assess their medical students appropriately. Because assessment is often the least understood component in the educational system, it too often becomes an afterthought; something created after the teaching is complete (Orlando, 2011). Treating assessment as a component outside of the educational process is problematic. In these instances, assessment often becomes the weakest, least effectively implemented component of the educational system (Orlando, 2011). When measuring curricular success by overall student performance, instructional and assessment methods have a relationship with summative outcomes. However, literature has increasingly demonstrated the importance of formative assessments, and the positive effect they have on student outcomes (Cauley & McMillan, 2010; Gibbs & Simpson, 2004; James & Fleming, 2004; Jimaa, 2011; Mauch, 2013; Yorke, 2010; Yu & Li, 2014).

Research on formative assessment has been done by both instructional design practitioners and academic researchers. Instructional designers focused on implementation methods and the role educational technology (Cauley & McMillan, 2010; Caldwell, 2007; Jenkins, 2005) and increased the visibility of formative assessments as an important part of teaching and learning. Academic research has demonstrated the positive effect formative assessments have on student outcomes (Cauley & McMillan, 2010; Gibbs & Simpson, 2004; James & Fleming, 2004; Jimaa, 2011; Mauch, 2013; Yorke, 2010; Yu & Li, 2014). This study focuses on faculty perception of formative assessment and how their implementation practices, with or without educational technology, are influenced by their perception.

Background of the Problem

Increased emphasis on summative assessments over the past two decades has prompted many changes and approaches to measuring learning in K-12 and higher education. In medical schools, not unlike most professional institutions, the milestones for becoming a physician have always required high-stakes assessments.

Historically, the onus of failure was placed firmly upon the student and what was considered their level of educational effort. (Report from The Center for Digital Education, 2014). Over time, there was a shift in the interpretation of success and failure. The shift occurred in the role of assessment in measuring student success: an assessment pedagogy that no longer relied solely on test-taking and summative assessment to measure success. Recognition that traditional approaches to assessment were no longer sufficient led to the adoption of new assessment methods and strategies. New assessment

tools and approaches allowed educators to begin focusing on the role of formative assessment (Report from The Center for Digital Education, 2014). Successful teaching and learning has evolved into a relationship between instructor performance and teaching methods, and that of student self-regulation of learning and engagement (Report from The Center for Digital Education, 2014). "A common method advocated to improve student achievement is the use of formative assessments, both to improve the pedagogical practices of teachers and to provide specific instructional support for lower performing students" (Dunn & Mulvenon, 2009a, p. 1).

Numerous definitions and explanations of formative assessment are found throughout the literature. In this study, I used Bennett's (2011) definition: "Formative assessment is a process used by teachers and students during instruction that provides feedback to adjust ongoing teaching and learning to improve students' achievement of intended instructional outcomes" (p. 6). Additionally, Garrison & Eringhaus (2011) assert that formative assessments are assessments incorporated into the learning activity as a means of *practice*, and should provide feedback to both the instructor and student from which alterations in both teaching and learning can take place. Information provided by formative assessment ideally allows faculty and students opportunities to improve their efforts. Formative assessments are used to assess student progress on a regular, ongoing basis, in which feedback in the form of advice and guidance are key and are used to make judgments about the quality of student responses and how to enhance the student's competence (Sadler, 1989). Additionally, formative assessments are a way to acquire information used to improve pedagogical practices (Dunn & Mulvenon, 2009).

Faculty trained in a particular content area outside of education may not fully grasp the educational process and effective teaching strategies that maximize student learning. As a result, faculty may struggle to implement formative assessments effectively. The effectiveness of an assessment is dependent upon several elements related to the characteristics of the faculty (Black & Wiliam, 1998; Brown, 2004; Kerr et. Al., 2006; Stefani, 2004; Wiliam & Black, 1996):

Faculty may be:

- content experts with only a basic understanding of the educational process
- unfamiliar with formative assessments in general
- unfamiliar with educational terminology (i.e. formative vs summative assessments)
- unaware of the different types of formative assessments and the technology available to carry them out
- unaware of the purpose for implementing formative assessments
- unfamiliar with when or how often to implement formative assessments
- unaware of how to use and provide formative feedback to students

Student learning is dependent upon the effective use of assessments, the feedback generated from formative assessment, and the ability to make necessary changes along the way (Nicol & Macfarlane-Dick (2004).

Technology provides new opportunities for incorporating formative assessment in the classroom. According to the Center for Digital Education (2014), "Recognizing traditional approaches to assessment are no longer sufficient to meet the needs of today's learners…education leaders are adopting new strategies and technologies to measure

student success" (p. 3). Emerging educational technologies have revolutionized how teaching and learning occurs and support the shift in focus from summative assessments to the ongoing, progressive nature of formative assessments. Educational technology enhances instructional and assessment approaches and fosters authentic assessments that provide useful and immediate feedback to both the instructor and the student (Center for Digital Education, 2014). Pastor (2011) explains

> this change in approach implies a change in methodology and in planning and assessment systems used by a large segment of university professors, both in the way of organizing and carrying out class activities, as well as in how students learn and are assessed (p.26).

Instructional efforts related to formative assessment implemented without suitable knowledge or preparation, however, create the risk of obstructing student progress. Optimizing efforts of both the instructor and student is ideally the goal in any educational setting. Research suggests the use of continuous formative assessments throughout the educational experience has a positive impact on student learning and outcomes (Cauley, K. & McMillan, J., 2010).

Additionally, faculty perception of the use or importance of formative assessment likely contributes to the successful or failed implementation of formative assessment within the instructional process, and faculty attitude, types of formative assessment, delivery methods, and feedback practices each contribute to the implementation process (Heritage, 2007). What is unknown, however, is how faculty perception of formative assessment influences their implementation practices. Given that there is little evidence

to support this concept, research is needed to examine faculty's perception and experience with formative assessment (Cauley & McMillan, 2010; Gibbs & Simpson, 2004; James & Fleming, 2004; Jimaa, 2011; Mauch, 2013; Yorke, 2010; Yu & Li, 2014). The study presented here is a step towards meeting this need.

Theoretical Framework

Medical education and research has a long history of being epistemologically objective, or realist, in nature. The realist view suggests knowledge is separate from reality, that knowledge is accessible but hidden, and that, at most, we can make claims of accurately depicting reality (Colliver, 2002a). However, "the increasing abstraction of scientific knowledge made the realist theory of correspondence harder and harder to maintain" (Colliver, 2002a, p. 49). In contrast, Constructivism is a view in which knowledge is created or constructed based on interactions with the world in which we exist. From this viewpoint, knowledge or meaning cannot be objective or discovered; rather it is constructed (Crotty, 1998). The distinction between constructivism as an epistemological view versus a theoretical perspective appears blurred at times as the term is used in two different contexts: as an epistemological stance and as a theory of how people learn, or as a theoretical perspective.

For this study, distinguishing constructivism as an epistemology versus as a learning theory required understanding that the epistemology determined my study's methodology while constructivism as a learning theory informed my decisions on the design of the study. Within educational research, when constructivism is referred to as an

epistemology, it makes claims that knowledge is constructed as opposed to accessed from a previously hidden reality (Colliver, 2002a).

> Constructivists in education promote a set of mandates that favor one view of knowledge (constructivism) over another (realism) and act as if these are principles of learning/instruction that capture the underlying learning process (how we learn) with the implications for instruction (how we should teach to optimize learning) (Colliver, 2002a, p. 50).

Constructivism as an epistemology aligns with my understanding that the learner interprets and constructs reality (or knowledge) based on their experiences and interactions with the environment (von Glasersfeld, 1995). Therefore, my epistemological stance of constructivism provides the purpose for choosing Q methodology for this study because it focuses on the views and internal frame of reference of the participants; an exploratory study of faculty perception which directly relates to their construction of knowledge and understanding. Q methodology is more interested in the analysis of the constructions of knowledge than in those who actually construct them (Stainton Rogers, 1995; Duenckmann, 2010).

In relation to constructivism as an epistemological stance, constructivism as a learning theory emphasizes the process of learning, and not the product; concept development and deep understanding are the focus (Fosnot, 1996). In this study, faculty perceptions are viewed as a means for gaining insight into how they understand formative assessment based on their environment or experiences. According to Doolittle and Hicks (2003), employing constructivism as a theory for learning requires understanding that the

following list of constructivist principles are purposefully overlapping and intersecting theoretical principles:

- Construction of knowledge and meaning making is an interaction between social and individual processes.
- Construction of knowledge requires a social connection within the cultural context in which one exists.
- Construction of knowledge is promoted by authentic and real-world learning environments.
- Construction of knowledge happens within the individual's frame of reference or prior knowledge.
- Construction of knowledge is fostered more so through engaging and interacting with multiple representations of content, skills, and social contexts.
- Construction of knowledge is promoted by self-regulation and self-awareness.

The distinction between constructivism as a viewpoint from which all knowledge is attained (epistemology), and the theoretical perspective from which learning is facilitated through instructional methods which foster the construction of meaning and knowledge has been identified for this study. Therefore, I employed Q methodology in my exploratory study of faculty perception of formative assessment in order to better understand if their perceptions of formative assessment influence their implementation and pedagogical practices.

Research Questions

In order to develop a better understanding of how faculty perception may influence implementation practices, this study sought to answer these research questions: 1) What are faculty perceptions of formative assessments with or without technology? 2)

How does faculty perception of formative assessments influence implementation practices?

Importance of the Study

This Q methodology study examined faculty perception of formative assessments and the possible influence of perception on their instructional implementation practices. Determining the value faculty place on formative assessment and its relationship to their implementation practices will give instructional designers greater insight into faculty awareness and comfort with both formative assessment and teaching with educational technology. The results of this study will provide both faculty and instructional designers with information that can be used to identify and create appropriate development opportunities related to understanding and implementing formative assessment.

Researcher's Role

As the Director of Curricular Affairs, Instructional Design, and Academic Technologies at the medical school being studied, I have a positive working relationship with the faculty involved in the study. Additionally, as an instructional designer at the institution used in the study, I have had multiple opportunities to establish professional relationships of mutual respect with both the faculty and students.

Definition of Terms

Formative Assessment - Ongoing process of assessment used by teachers and students during instruction, which provides feedback that allows students to improve achievement of instructional outcome goals (Bennett, 2011).

Summative Assessment - End of instruction assessment used to judge or evaluate the overall student achievement of instructional outcome goals.

Q Methodology - a method in which subjectivity is statistically analyzed in order to establish patterns within and across persons (Barry & Proops, 1999)

Q sample (Q set) - subset of statements generated from a larger concourse or pre-existing inventory that are presented to the participants in the form of a Q sort.

P set - group of participants asked to conduct a Q sort.

Q sort - ranking of statements by participants according to set conditions of instruction

CHAPTER II

REVIEW OF LITERATURE

Over the past few decades, expectations of faculty teaching practices have shifted from a focus on summative assessment measures to a focus on the ongoing learning process (Stefani, 2004; Orlando, 2011). Recognition of this process prompted educational research efforts centered on the nature and importance of formative assessments. The amount of educational research related to formative assessment is quite impressive. However, there is very little research addressing the effect that faculty perceptions and implementation of formative assessments have on student achievement of learning outcomes (Cauley and McMillan, 2010; Gibbs and Simpson, 2004; James and Fleming, 2004; Jimaa, 2011; Mauch, 2013; Yorke, 2010; Yu and Li, 2014).

Bennett (2011) provides a critical review of six very common and interrelated issues regarding the use of formative assessment:

- The definition issue- Are formative assessments used as an instrument or diagnostic test? Are formative assessments used within a larger process?

- The effectiveness issue- Are formative assessments implemented as intended? Is participation in formative assessment positively influencing student outcomes?
- The domain issue- Do faculty have a weak cognitive-domain understanding of formative assessment which hinders implementation?
- The measurement issue- Do faculty understand what inferences to make from the evidence elicited from formative assessments?
- The professional development issue- Is formative assessment an activity rooted in pedagogical knowledge?
- The system issue- Are administration or faculty changing the system to accommodate formative assessment?

Implementation of formative assessment is a common thread through the six issues discussed by Bennett (2011), yet faculty perception and implementation practices related to formative assessment were not addressed. According to the same literature review, faculty perception of formative assessment and its influence on implementation practices have not been widely researched. Therefore, the purpose of this study was to examine faculty perception of formative assessments and the possible influence of perception on their instructional implementation practices. This chapter reviews the literature relevant to this purpose and integrates formative assessment literature regarding the historical component, types, implementation, perception, feedback, technology, and use in medical education to demonstrate the need for this study.

Historical Context of Formative Assessment

The concept known as formative assessment was first introduced by Scriven (1967), who proposed a differentiation between formative assessment - evaluation intended to facilitate program improvement - and summative assessment - evaluation aimed at judging the overall value of an educational program (Bennett, 2011). Two years later,

Bloom (1969) proposed the need to further distinguish formative assessment as the application of evaluation to student learning. Although Bloom (1969) agreed that assessments traditionally served to evaluate student learning,

> Quite the contrast is the use of "formative evaluation" to provide feedback and correctives at each stage in the teaching-learning process. By formative evaluation we mean evaluation by brief tests used by teachers and students as aids in the learning process. While such tests may be graded and used as a part of the judging and classificatory function of evaluation, we see much more effective use of formative evaluation if it is separated from the grading process and used primarily as an aid to teaching (p.48).

Both Scriven (1967) and Bloom (1969) highlight the importance of assessment to change, or influence, the teaching and learning process.

Throughout the 1990's, understanding formative assessment at all educational levels became paramount as summative assessments were becoming the standard by which students, and often teachers, were evaluated. The term formative assessment did not yet have a firmly defined and widely accepted definition (Black & Wiliam, 1998a). Black and Wiliam (1998a) interpret formative assessment "as encompassing all those activities undertaken by teachers, and/or by their students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged" (p.7-8). Early in their study, Black and Wiliam (1998a) realized that when a greater amount of attention and effort was given to the use of formative assessment, significant learning gains were achieved, thereby providing evidence of the positive

impact on learning outcomes even in the early stages of research on the topic of formative assessment.

In a later publication, Black and Wiliam (1998b) resumed their discussion on the impact of formative assessment on raising achievement outcomes. They indicated that all activities performed by teachers and students that provide feedback used to modify the learning process are considered formative in nature, and they offered this as a working definition of formative assessment.

Wiliam (2006) suggested evaluation at any level is formative if the data generated was used to reflect and make changes to the teaching and learning process, especially if changes would otherwise not be made. Evaluation of student achievement is formative if it impacts student learning and outcomes (Wiliam, 2006). "Assessments are formative, therefore, if and only if, something is contingent on their outcome, and the information is actually used to alter what would have happened in the absence of the information" (Wiliam, 2006, p. 284). From the extensive literature review by Black and Wiliam (1998a) it is apparent that assessment and teaching are not mutually exclusive and should be reciprocal, yet the concept of this reciprocity is not fully accepted by faculty. (Heritage, 2007).

Since the 1990's, assessment has been a rising challenge for educators at all levels. One part of the challenge is understanding how formative assessments exist within the teaching process. Dunn and Muvenon (2009b) suggest this may be a consequence of not having a widely accepted definition for the term formative evaluation or formative assessment.

> Formative assessment and its various manifestations were defined not only by inherent characteristics, but also by the use of the assessment outcomes. Formative assessment's status as an ethereal construct has been perpetuated in the literature due to the lack of an agreed upon definition. The vagueness of the definition directly contributes to the weaknesses found in the related research and dearth of empirical evidence identifying best practices related to formative assessment (Dunn & Mulvenon, 2009b, p.4).

Interestingly, O'Brien (2008) describes formative assessment as a component that exists within the teaching process. Formative assessment is the part of the conversation where teachers seek to determine what the student does or does not understand (O'Brien, 2008). Popham (2008) described formative assessment as a process, but purposefully planned and dedicated to the acquisition of feedback for the specific use of making adjustments in instruction. Additionally, Wiliam (2006) suggested

> What makes assessment formative, therefore, is not the length of feedback loop, nor where it takes place, nor who carries it out, nor even who responds. The crucial feature is that evidence is evoked, interpreted in terms of learning needs, and used to make adjustments to better meet those learning goals (p. 285).

Black and Wiliam (1998a) indicated that formative assessments provide information used as feedback for the purpose of evaluation, diagnosis, or prediction. Perie, Marion, and Gong (2007) suggest a distinction between formative assessment and what they call interim assessment. "Interim assessment is the term we suggest for assessments that fall between formative and summative assessment, including the

medium-scale, medium-cycle assessments currently in wide use" (Perie, Marion, & Gong, 2007, p. 1). Therefore, they suggested that the assessment is formative if the goal is to use feedback to make adjustments to the teaching and learning process. Additionally, the assessment is considered interim if the feedback is used to create awareness of student achievement or to inform curricular decisions. On the surface, there seems to be a clear distinction between the two, however, confusion among educators and within the literature arose when one singular assessment was employed to serve both purposes in the teaching process (Dunn & Mulvenon, 2009a).

Although formative and interim assessments seem to be more closely aligned in terms of their employment, a greater level of confusion occurred with distinguishing between formative and summative assessments. "The key difference between these two types of assessment is not when they are used but their purpose and the effect that these practices have on students' learning" (Hernandez, 2012, p. 490).

Summative assessments are given at a specific and planned point in time to assess student understanding of the concepts taught up to that point. The purpose of summative assessments is to assign a grade with a sense of finality as opposed to promoting instructional or learning changes (Garrison & Ehringhaus, 2007). This is not to say that assessments cannot function as aids to learning, however, and it seems counterintuitive to have overlapping purposes since they seem in conflict with one another (Hernandez, 2012).

Bell and Cowie (2001) suggest that formative and summative assessments may legitimately be used interchangeably, yet Sadler (1989) suggests that formative and

summative assessments are in direct contrast with one another in their definition and purpose. "The primary distinction between formative and summative assessments relates to purpose and effect, not to timing…many of the principles appropriate to summative assessment are not necessarily transferrable to formative assessment; the latter requires a distinctive conceptualization and technology" (Sadler, 1989, p. 120). Additionally, Chappuis and Chappuis (2007) state,

> Formative assessment… delivers information *during* the instructional process, before the summative assessment. Both the teacher and student use the formative assessment results to make decisions about what actions to take to promote further learning. It is an ongoing, dynamic process that involves more than frequent testing, and measurement of student learning is just one of its components (p. 2-3).

Dunn and Mulvenon (2009a) continue by suggesting "Although an assessment may be designed and packaged as a formative or summative assessment, it is the actual methodology, data analysis, and use of the results that determine whether an assessment is formative or summative" (p. 2). Adding to the confusion in the terminology of formative and summative assessments, Wininger (2005) studied the effectiveness of using formative summative assessments (FSA) by both students and teachers using the feedback from exams to make teaching and learning decisions. However, Stiggins (2002) suggests an inherent and essential need for a clear distinction between formative and summative assessment in terms of 'assessment for learning' and 'assessment of learning' respectively. Summative assessments "cannot diagnose student needs during learning, tell

students what study tactics are or are not working…These kinds of uses require assessments *for* learning" (Stiggins, 2002, p. 763).

The distinction between the different types of assessment, specifically formative and summative assessment, is an ongoing conversation among educational researchers. However, perhaps the lack of clarity regarding the purpose of formative assessment still exists is due the unfamiliarity with the different types of formative assessments.

Types of Formative Assessments

Literature has well established the purpose of implementing formative assessment with instruction, however, the type of assessment employed must be explored further (Krasne et. al., 2006; Heritage, 2007; Wiliam, 2006). Just as educational researchers differ in opinion regarding the definition of formative assessment, they hold differing views on how to classify the types of formative assessment. Heritage (2007) suggested that the type of formative assessment is determined based on the 'timing' of the assessment within the instructional process, not on the duration of the assessment. She offered three broad types of formative assessment based upon when they are employed throughout the instructional process: on-the-fly assessment, planned-for interaction, and curriculum-embedded assessment. Heritage (2007) describes each type as the following:

> On-the-fly assessment - On-the-fly assessment occurs spontaneously during the course of a lesson. The "pop-up" lesson enables the teacher to clear up the misconceptions before proceeding with the planned instructional sequence.

Planned-for interaction - In planned-for interaction teachers decide beforehand how they will elicit students' thinking during the course of instruction. It enables students to explore ideas, and these questions can elicit valuable assessment information.

Curriculum-embedded assessment - There are two types of curriculum-embedded assessments, those that teachers and curriculum developers embed in the ongoing curriculum to solicit feedback at key points in a learning sequence and those that are part of ongoing classroom activities (p. 141).

The goal of each of the three types of formative assessment is to gather feedback that can be used to take action and make changes within the learning process, therefore being formative in nature. On the other hand, Wiliam (2006) suggested three different types of formative assessments: Long-cycle, Medium-cycle, and Short-cycle. Wiliam (2006) also determined that the type of formative assessment is dependent upon what data is collected and how it is used rather than the length of time or the timing of the assessment within the instructional process. Table 1 reports the foci and duration of the three types of formative assessments according to Wiliam (2006).

Table 1. Type of Formative Assessment

Type	Focus	Length
Long-cycle	Across marking periods, semesters, years	4 weeks to 1 year or more
Medium-cycle	Within and between teaching units	1 to 4 weeks
Short-cycle	Within and between lessons	5 sec to 2 days

The assessments described in Table 1 contain several critical features: 1) evidence of learning is produced, 2) results are interpreted in terms of learning needs, and 3) adjustments made to better meet those learning needs" (Wiliam, 2006).

Purpose and Implementation of Formative Assessments

As mentioned previously, Sadler (1989) defined formative assessment as the intention to assess and provide feedback to both the instructor and learner in order to improve performance. A decade later, Bell and Cowie (1999) expanded this idea and defined formative assessment as "the process used by teachers and students to recognize and respond to student learning in order to enhance that learning, *during learning*" (p. 198). This marked a shift in thought regarding formative assessments as methods or activities existing within, rather than outside, the realm of instruction. Carol (2002) supported this shift by indicating formative assessments should be used throughout the instructional process. Additionally, Black, et. al., (2003) suggested the overriding purpose of formative assessment is to enhance or promote student learning.

Ideally, formative assessments are used, at any educational level, to identify areas of improvement for both the instructor and the student. However, when used improperly or ineffectively, formative assessments can take up time and space in the curriculum with little to no added value to the overall learning process. For example, "Implementing clickers into a course is thought to be largely ineffective unless accompanied by appropriate constructivist elements" (White et al, 2011, p. 552). Students report that an instructor's use of clickers to assess simple recall without discussion or explanation serves them very little in the way of the learning process (White et al., 2011). Providing students with invalid or ineffective feedback on their work or responses could potentially be detrimental to the learning process (Sadler, 1989). Therefore, effective feedback is key when using formative assessments, not only for instructional self-awareness, but for student self-regulation as well.

Faculty Practice and Perception of Formative Assessment

To many faculty members, assessment is synonymous with summative, or high-stakes exams, and the concept of formative assessment is far less known and understood (Heritage, 2007). Faculty awareness of how assessment 'fits' within the instructional process is central to creating the bridge between teaching and learning. "Assessment occupies such a central position in good teaching because we cannot predict what students will learn, no matter how we design our teaching" (Wiliam, 2011, p. 46.) because teaching does not always equate to learning (Wiliam, 2011). The need for assessment is justified in order to determine the learning (Wiliam, 2011), however, the assessment itself must be purposeful for the specific learning opportunity and faculty often struggle with this determination. The accountability environment in medical school

and higher education often portrays assessment as something that must be implemented outside the realm of instruction; a tool for capturing student's final knowledge (Heritage, 2007). According to Stiggins (2002), faculty are "unschooled in the principles of sound assessment" (p.762), and faculty learn how to teach without learning much about how to assess (Heritage, 2007). Based on the literature, faculty do not deny the importance of formative assessment, but do question to what extent they should use formative assessment at the expense of summative assessment; their understanding of assessment remains rooted primarily in the summative aspect of assessment (Kadri et. al., 2009; Dylan, 2007).

When formative assessments are effectively implemented, the results can provide faculty with useful data to make informed decisions about the teaching and learning process (Heritage, 2007). However, faculty often already feel that time to teach versus time dedicated to assess is burdensome, and they view formative assessment as another external demand that will take time away from their teaching (Heritage, 2007; Al-Wassia et. al., 2015). There are several factors related to the use of formative assessments in teaching: commitment, planning, and flexibility (Wiliam, 2011). Embracing the time commitment needed to plan and the flexibility necessary for implementation is often a challenge for faculty. Embedding formative assessments into instruction places pressure on faculty to 'do more': meaning using the time and resources necessary to assess student learning appropriately. "Sometimes, a teacher does her best teaching before the students arrive in the classroom" (Wiliam, 2011, p. 49). Faculty perception of formative assessment is often influenced by the perceived time investment associated with using formative assessments. Faculty often have difficulty with reconciliation of a balance

between the workload associated with using formative assessments and their other academic responsibilities (Al-Wassia et. al., 2015).

Additionally, faculty frequently struggle with understanding the role of a formative assessment, which is to ensure that student learning is progressing in the direction in which the instructor intends, and often prior experience shapes their perception, understanding, and use of formative assessments (Wiliam, 2011). Black and Wiliam (1998) identified several key weaknesses in faculty practices with formative assessment:

- Classroom formative assessment practices more often than not encouraged superficial learning
- Instructor formative feedback or review did not occur on a regular basis
- Formative assessments were weighted to heavily making them high-stakes assessments
- Normative rather than criteria-based assessments were often used, which negatively influenced weaker students' motivation

Black and Wiliam (1998) suggest that faculty are not aware enough of colleagues' assessment practices, or the research supporting pedagogical practices with formative assessments. In order for faculty to implement formative assessments well and use the information to inform instructional practices, faculty need "deep content knowledge, conceptual understanding as well as pedagogical content knowledge" (Al-Wassia et. al., 2015, p. S15). Literature suggests that faculty often feel they have inadequate content knowledge in the overall concept of formative assessment and its role in the enhancement of learning, and that faculty development is the key to improving their pedagogical

practices related to formative assessment. (Al-Wassia et. al., 2015; Ginsburg, 2009; Perrenoud, 1998).

In the past, faculty regarded formative assessments as completely separate from the teaching and learning process, a formal activity providing final results, instead of an opportunity to self- regulate instruction or learning (Torrance & Pryor, 1998). Yu and Li (2014) suggest that a small shift in faculty mindset towards formative assessment is occurring, allowing them to better accept and understand the essential role formative assessments have in the teaching and learning process. However, many faculty are graduates of traditional curriculum where formative assessments were not used, and many still do not fully understand the meaning and purpose of formative assessment, which likely influences their perception and implementation of formative assessments in their own teaching practices (Yu & Li, 2014; Kadri et. al., 2009). Without faculty appropriately understanding the role that formative assessment plays in the teaching and learning process, their implementation skills will remain dormant (Heritage, 2007; Koh, 2010).

Consequently, because many faculty still do not fully understand the role of formative assessment in their teaching process, there is still a great need to publish literature and examples demonstrating the importance and correct implementation of formative assessments (Yu and Li, 2014).

Formative Assessment for Feedback and Self-Regulation

Faculty use formative assessment feedback to make informed decisions about how they are teaching, when to teach particular content, and how well students learn the

content (Sadler, 1989). It is important to recognize what formative assessments are, their purpose, and the benefits of their use before attempting implementation. Without a solid understanding of the key components of formative assessment, specifically the feedback component, the learning process may not be optimal for improving student outcomes. For example, according to Clark (2011), feedback given to students related to *how* performance can be more effective have a positive impact on the student's learning process and outcomes. Effective feedback is "the most powerful single moderator that enhances achievement" (Hattie, 1999, p. 9). Conversely, students receiving feedback in the form of a verbal praise, acknowledgement, or disapproval report lower outcome measures (Clark, 2011).

> Feedback becomes formative when students are provided with scaffolded instruction or thoughtful questioning that serve as prompts for sustained and deeper discussion. This instructional approach closes the achievement gap between current level of understanding and the desired learning goal. Simply telling the students to 'try again' or 'reconsider your work' does not possess the qualities of formative feedback because it does not strategically guide (or scaffold) learning by telling the student how or why they need to do this (Clark, 2011, p. 162).

Before implementing formative assessments, instructors must understand the impact of using, or not using, formative feedback. McCallum (2000) reviewed six different studies on formative assessments and provided clear descriptions of four key components of formative assessments that must be considered when planning assessment strategies.

Regular planned 'assessment incidents'. McCallum (2000) insists that faculty are assessing constantly. However, he also indicates that faculty mistakenly subordinate assessment to teaching. "The implications are that if formative assessment is to be effective, incidents need to be planned" (McCallum, 2000, p.3). This requires structured methods of obtaining feedback within structured lessons.

Regular pupil self-assessment. McCallum (2000) suggested that regular reflection on one's learning, learning strategies, and analysis of work is an essential part of formative assessment. The implication requires a systematic approach by faculty supported by understanding that both student and faculty buy into the idea that self-assessment supports growth. Black and Wiliam (1998) concluded that "collaborative discourse can lead to self-reflection and significant gains in learning - therefore the more opportunities there are for conversation the better" (p.9).

Feedback for learning. Feedback is information that is provided to the learner about his or her performance during the learning process, and is most useful when faculty help students use the information to improve their learning (McCallum, 2000). According to Black and Wiliam (1998), at the core of formative assessment are two important, sequential actions:

- a learner self-perceived learning gap between what should be known and what has not been learned, and
- the action taken by the learner to close the gap and achieve the learning goal

Additionally, faculty should provide useful and relevant, focused, and descriptive feedback in various formats (McCallum, 2000).

Adjusting teaching to take account of the results of assessment. The Assessment Reform Group (ARG) (1999) suggested the importance of reflecting upon assessment data to adjust teaching practices promotes student learning. It is through feedback that both the faculty and student benefit. Faculty must make adjustments in their teaching process that allows them to facilitate learning in order to close the learning gap (McCallum, 2000). Maximizing the efforts of both faculty and student through formative assessment and feedback means appropriate awareness of these components.

More often than not, faculty are more concerned with the content being taught than the plan for which they intend to assess knowledge of the content (Jimaa, 2011). As a result, the assessment component of the learning process is relegated to an afterthought, when ideally it should be the primary component addressed in the pre-planning of the course (Jimaa, 2011). Creating 'impromptu' assessment opportunities is perilous for several reasons:

1. the assessment item(s) will not likely align with the content taught -- this serves no purpose for the assessment
2. the assessment item(s) will not likely align with the way in which the content was taught
3. the assessment item(s) will not likely align with the level at which the content was taught, or the expected level at which the student should acquire the knowledge

Each reason above highlights the necessity for planning as it relates to the assessment component of the teaching and learning process (Jimaa, 2011).

The attention placed on creating assessments by the content experts, especially in medical schools, can often be too focused on the summative assessment. However, as

more literature becomes available regarding formative assessments, it is clear that formative assessments are a crucial component of the educational process, yet often disregarded. As mentioned previously, the use of formative assessment in the teaching and learning process results in "significant and often substantial gains", even though their use is often riddled with issues that could hinder the beneficial nature of the intention (Black & Wiliam, 1998).

Many faculty have little experience with the use of formative assessments. According to Black and Wiliam (1998), three issues arise most often: 1) ineffective learning, 2) negative impact of the assessment, and 3) managerial rather than instructional assessments. They conclude that students should be taught the art of self-regulation through effective formative assessment feedback in order to understand the purpose of their learning and what is needed to achieve their learning goal (Black & Wiliam, 1998). Nicol and Mcfarlane-Dick (2006) suggest that both formative assessment and feedback should enable students to self-regulate their learning. Faculty who use formative assessments, but do not engage the student with feedback, deny students opportunities for the empowerment and improvement in which useful feedback provides. Immediate feedback allows faculty members to change the course of their lecture 'on the fly' in order to truly address the students' gaps in knowledge before it is too late. Additionally, faculty may use immediate feedback to confirm 'a job well done' and adjust lecture time spent on material the students have not mastered.

Use of Technology to Facilitate Formative Assessment

Educational technology resources have grown tremendously over the past decade, and delivery methods of formative assessments have also been enhanced. Brown and Glasner (1999) claims that "around 80% of assessments the world over are in the form of exams, essays, and reports" (p. 8). There was an assumption that with the increase in innovative educational technologies, assessments would take on more innovative forms and formats. "A re-evaluation of the assessment methods might be expected to be a prominent feature of a critically-based educational program involving less hierarchical procedures and relationships - particularly one which aims for pedagogical consistency between the curriculum and the teaching methodology. Yet, while examples of critical pedagogies, including those situated online are accumulating, they seldom exhibit corresponding changes in assessment practices" (Trehan & Reynolds, 2002, p. 280).

Computer-Based Formative Assessment Method. Computer-based formative assessment is one type of technology-enhanced assessment. Jenkins (2005) focused on computer-aided formative assessment and the issues surrounding successful implementation via computer technology. The inception of computer–based assessment has made assessing students more time efficient (Jenkins, 2005). However, there is the lingering impression by faculty that the efficiency afforded by using multiple-choice (MCQs) or true-false (T/F) questions should be the primary purpose for using computer-based assessment. Unfortunately, this creates a very limited view of how formative assessments can be implemented (Jenkins, 2005).

Computer-based assessment software provides "huge potential for promoting more imaginative applications…including peer-assessment, self-assessment, group-based assessment, and objective testing" (Jenkins, 2005, p. 69). Feedback from formative assessments is a compelling force behind their relevance and usefulness. Computer-based assessments allow for more immediate feedback in order to make informed instructional adjustments. Additionally, computer-based assessments often provide the ability to scaffold and guide students through their learning with tutorial modes and help individualize the learning process (Jenkins, 2005). Charman (1999) was aware of the benefits of computer-based assessments well before educational technology became standard in classrooms and identified its advantages (Jenkins, 2005):

- Repeatability of assessments
- Immediacy of feedback to students
- Immediacy of feedback to instructor
- Fairness and reliability of assessment method
- Diversity of assessments
- Increased objectivity
- Efficiency of time
- Accessibility
- Increased student interest in using technology
- Increased self-awareness and responsibility by the student

Generally, these benefits remain true today as the technology and computer-based assessment software is continually improving. Nevertheless, possible disadvantages still

remain. When technology performs its intended tasks, and provides desired or expected results, it is considered a useful and relevant tool. However, when technology fails, assessment feedback becomes potentially difficult to provide (Peat & Franklin, 2002). With the growing class size in most higher education institutions and professional schools, meeting the needs of students is a challenge, and employing computer-based assessments potentially addresses this challenge.

Miller (2009) discusses merging formative assessment theory with the use of computer-based assessment, specifically in higher education. She suggests that large class sizes, in combination with diverse backgrounds of students in undergraduate classes, hinder faculty's ability to meet the needs of each individual learner. However, Miller (2009) also indicates the necessity for computer-based assessments to alleviate these issues. Allowing students to determine when and where they complete the assessment provides flexibility, and therefore computer-based assessments help meet the needs of the learner. The role of the traditional student is not always the norm in colleges and universities, and in order to adequately meet the needs to the greatest number of students, non-traditional formative assessments must be embraced (Miller, 2009). "The purpose of computer-based formative assessments is to promote independent learning while focusing on feedback to improve student learning" (Miller, 2009, p. 182). Computer-based assessments allow students to assess their knowledge at a time and place most conducive to their situation at the time. Embedding the assessment into the learning process provides feedback that allows students to self-regulate their learning. Additionally, faculty often receive immediate feedback in this scenario, which informs their teaching methods and instructional decisions moving forward.

Student Response System Formative Assessment Method. A second type of technology-enhanced formative assessment method is the use of student response systems (SRS) or "clickers". Clickers are small transmitters that students use to provide answers electronically to assessment questions provided by the faculty via their presentation (Caldwell, 2007). Student response systems are very popular in higher education and professional education as a means to assess in real-time the learning progress of students in large classes. Although most response system programs accommodate a variety of question types, multiple choice and true/false questions are most commonly used. Best practices regarding the use of clickers indicate that two to five questions per each 50-minute instructional period is sufficient and optimal (Caldwell, 2007). Additionally, according to Caldwell (2007), there are nine common uses of clicker questions which ideally enhance the teaching and learning experience:

- To increase interaction among individuals or with peers
- To assess student readiness
- To learn about the learners
- As ungraded, informational formative assessments with feedback
- As graded quizzes for assessment
- As a means for practice
- To guide thinking and problem solving
- To conduct experiments
- To make a lecture more interactive and less passive

Clickers are a versatile tool for the instructional and learning process. It is essential however, that the purpose for using clickers aligns with the learning goal. Not

all faculty have positive feelings towards the use of clickers. Technological problems or lack of faculty development opportunities are among the various reasons faculty shy away from their use (Caldwell, 2007). Additionally, faculty worry that conducting formative assessments using clickers interferes with instructional or lecture time. Therefore, first aligning the method with the purpose of a formative assessment must be considered, followed by the implementation using research-based best practices. Research suggests that the following list of best practice approaches should be followed when implementing formative assessments using SRS or clickers (Caldwell, 2007):

- Know why you are using clickers in class
- Plan your grading system in advance and align with learning goals
- Plan for students without clickers (broken, forgotten, lost, etc.)
- Observe others using clickers before employing their use for the first time
- Be mindful of extra prep to generate appropriate questions
- Explain to students why you are using clickers and your expectations
- Plan discussion time during formative assessment with clickers
- Limit group size to 4-6 members if using peer learning
- Take the time to train students on clicker use
- Set up the system and do a test run before class use

Overall, there is consensus within the literature that student response systems are a powerful and manageable teaching tool (Caldwell, 2007). "Clickers can occupy either a peripheral or central role during class…they do seem to enhance students' active learning, participation, and enjoyment of classes" (Caldwell, 2007, p. 19). Clickers provide the means by which both faculty and students can receive immediate feedback to

determine not only course of further instruction, but for student self-awareness as well (Caldwell, 2007).

Formative Assessment and Student Engagement

The increase in instructional methods into which formative assessments are naturally embedded has raised questions in the literature regarding the level of responsibility the student internalizes regarding their own learning (De Wet & Walker, 2013). According to a study by De Wet and Walker (2013), students expressed discomfort or an aversion to the "constructive" nature of the learning method when asked about their experience and preference of learning in a problem-based activity environment. Students initially prefer what is known and comfortable; that which does not require a heavily invested role in constructing their own learning. However, after several formative assessments, students indicate that they feel more prepared to apply the material because of the way in which they were forced to learn the content (De Wet & Walker, 2013).

Nicol and MacFarlane-Dick (2006) concluded in order to effectively prepare students to perform beyond the classroom, in clinical reasoning in medicine for example, educational experiences must provide the appropriate opportunities to progress and develop, construct meaning from their learning experiences, and become self-regulated learners.

Conducting formative assessments should be an intentionally non-threatening means of assessment to gather information regarding student knowledge and faculty performance, while allowing students to assess their own learning process (Lutze-Mann

& Kumar, 2013, p. 526). "Thus, formative assessment greatly improves students' satisfaction with a course, as well as demonstrably improving their performance in subsequent summative assessment" (Lutze-Mann & Kumar, 2013, p. 526). The accuracy of this statement depends upon the perception of usefulness by the students and the method by which the instructor implements and engages students through feedback.

As previously mentioned, Caldwell (2007) found formative assessment with clickers for instantaneous feedback can be very useful if implemented employing best practices. Providing students with immediate feedback via polling results to a multiple choice or true-false question is clearly a procedure for issuing formative assessment. However, students cannot reach "consolidation of learning nor the rectification of misconceptions" (Lutze-Mann & Kumar, 2013, p. 526) if the discussion and clarification aspects of the process are omitted. Additionally, faculty using technology-enhanced formative assessments often rely on the technology to provide automated feedback to students and never engage students with clarification or discussion that would allow students to self-regulate their learning process (Wiliam, 2011). In these instances, students stop perceiving formative assessments as meaningful or valuable to their learning or their performance on the impending summative assessment, and "whether a student sees feedback as relating to something that is pertinent or transient depends on the student's attitude" (Wiliam, 2011), p. 118).

Ideally, students should experience formative assessments as part of a learning journey in which they actively participate. Formative assessments enhance learning only if students have opportunities to engage effectively and identify development needs (Evans et al., 2014). Students prefer engaging and stimulating assessment opportunities in

which they can regulate their learning (Evans, 2014; Harlen & James, 1997; Hudson & Bristow, 2006). To maximize the effect of formative assessments, the instrument, type and delivery method must be fundamentally purposeful within the curricular or learning process (Evans et al., 2014). Providing students with engagement opportunities that encourage faculty-student interaction in order to foster meaningful assessment feedback often relies upon delivery method of not only the content, but of the assessment as well. "What are needed are formative assessments, which provide students with opportunities to revise and improve the quality of their thinking and understanding. Thus, interaction and formative assessment are two agendas which hold equal importance in guiding the student approach to learning" (Chan et al., 2011, p. 323).

Formative Assessments in Medical Education

Undergraduate medical education is known for using high-stakes assessments to make decisions about student achievement of academic goals, and efforts for improvement are continual (Krasne et al., 2006). The concept of using formative assessments has garnered little awareness until recently. Formative assessments "are undertaken to help develop students' intellectual capabilities for improved achievement, to identify and act upon students' strengths and weaknesses, and to modify teaching practices if needed" (Krasne et. al., 2006, p. 156). Because medical school exams are considerably high-stakes, it is essential to use formative assessments in undergraduate medical education to improve student performance on summative assessments (Krasne et. Al., 2006).

The goal of an undergraduate medical student is to develop an expertise and proficiency in clinical reasoning. When faculty employ formative assessments, students can adjust their learning approach so that they learn the process, not just the final outcome or diagnosis (Krasne et. Al., 2006). Additionally, "greater retention of knowledge occurs when learning trials are spaced rather than massed" (Krasne et al, 2006, p.156). Intermittent formative assessments foster student engagement in the content on a regular basis versus a cram session before a summative assessment. Students who are exposed to formative assessments periodically in preparation for the final high-stakes exam show a significant increase in grade point (Zakrezewski & Bull, 1999).

There is a certain amount of invested planning and forethought that must be employed by the faculty to effectively use any method for formative assessments. In medical education, as with higher education, technology is often an encumbrance to faculty who feel inadequately prepared to interact with new technologies. Therefore, implementing technology-enhanced formative assessments must align well with the purpose for its use. Nicol and MacFarlane-Dick (2004) state "Assessment provides a framework for sharing educational objectives with students and for charting their progress" (p.1). They suggest the information received from feedback should allow students to regulate their learning and allow instructors to realign their teaching methods. Their contribution emphasizes the need for a purposeful use of the assessment (Nicol & MacFarlane-Dick, 2004).

Student acquisition of knowledge is greater when the student gains a deeper understanding of the content and can therefore apply it appropriately. This supports the importance of increased faculty willingness to embrace innovative and new teaching

practices as essential moving forward (Pastor, 2011). "This change in approach implies a change in methodology and in planning and assessment systems…as well as in how students learn and are assessed" (Pastor, 2011, p. 26). For many medical schools, a curricular change has either taken place, is currently taking place, or is in the planning stages of revision. It is noted by Pastor (2011), that a curricular change is not sufficient if the assessment methods are not modified or enhanced as well. In order to foster a deeper learning experience and gained knowledge on a higher level, students must be invested in their learning, and therefore involved in their own assessment. Formative assessments should not exist outside of the teaching and learning process, but inherently embedded within (Pastor, 2011).

Summary of Literature Review

Through this review of related literature on formative assessment, it is evident that faculty awareness of formative assessment is essential to effective implementation. Formative assessments improve student performance and achievement of learning goals when faculty understand the commitment and flexibility associated with them. Understanding the purpose of formative assessment and aligning implementation with the learning goals increases the usefulness of the assessment. Enabling faculty and students to self-regulate their teaching and learning processes respectively through the use of formative assessments has a positive effect on overall student outcomes.

CHAPTER III

METHODOLOGY

Past and present research on the topic of formative assessment examines their effectiveness, types, and implementation practices. However, there is little to no research that examines who the faculty are in terms of their attitudes, values, and perceptions towards formative assessment or the effect these things have on their implementation practices and student outcomes. Faculty assume a key role in the implementation of assessments; therefore, their perspectives about formative assessments must be studied (Black & Wiliam, 1989; Bennett, 2011; Yu & Li, 2014). Additionally, an instructional process in which student outcomes measure success or failure seems primarily contingent upon faculty implementation practices (Black & Wiliam, 1998). Faculty struggle with understanding the role of formative assessment—to enhance student learning in order to meet the intended goals of the instructional process (Wiliam, 2011). The purpose of this chapter is to explain the research design of this exploratory study that employs Q methodology along with a statistical analysis of faculty perceptions of formative assessment and their influence on implementation practices in pre-clinical medical education.

Research Questions

1. What are faculty perceptions of formative assessments with or without technology?

2. How does faculty perception of formative assessments influence implementation practices?

Q Methodology

The purpose of this study was to examine faculty perceptions of formative assessments and their relationship to implementation practices in pre-clinical medical education. The faculty at the medical school used in this study are considered content experts by the institution. Their backgrounds in education and teaching vary and their perceptions of formative assessment are undetermined. Q methodology is appropriate for examining these perceptions. It requires participants to make decisions about what is meaningful (or not) and valuable (or not) based on their personal perspectives and experiences (Watts & Stenner, 2005). McKeown and Thomas (2013) state the purpose of a Q study is to "discern people's perceptions of their world from the vantage point of self-reference. These viewpoints constitute the Q-methodological understanding of *subjectivity*" (p. 1). Q methodology uses inference to the best explanation, or abduction, to produce "a set of essentially *relative evaluations* (and hence a gestalt configuration of items)" (Watts & Stenner, 2005, p. 74). The value of these evaluations made by participants "must then be attributed *a posteriori* through interpretation rather than through *a priori* postulation. This is the basis of Q method" (Brown, 1980; Watts & Stenner, 2005, p. 74).

Various researchers have offered a variety of outlines or demonstrations for the use of Q as a methodology for mixed methods and qualitative studies (Ramlo & Newman, 2011; Shemmings, 2006; Eden, Donaldson, & Walker, 2005). William Stephenson, the creator of Q methodology, designed Q methodology so that it could be applied to both subjective and objective behaviors (Donner, 2001; Ramlo & Newman, 2011). Ramlo and Newman (2011) demonstrate how Q fits within existing mixed methods practices and insist there is a consistency with Stephenson's (1935, 1953) initial position on Q methodology—it can be effectively applied to both subjective and objective behaviors. According to Shemmings (2006) Q can be used as a complimentary alternative to traditional qualitative methods, while Eden, Donaldson, & Walker (2005) propose Q as a supplement to existing analytic methods used in human geography. Additionally, some researchers recognize Q methodology as a hybrid of sorts between qualitative and quantitative methods "involving as it does factor analysis, is an eminently quantitative procedure" (Stenner & Rogers, 2004, p.101) and addressing "emergent *Gestalten*- a form of output often associated with qualitative work" (Stenner & Rogers, 2004, p.101-102). William Stephenson established Q method as an adaptation of the quantitative techniques called factor analysis. There is a tendency for quantitative researchers to (mis)identify Q methodology's factor analysis with the more familiar factor analysis of R, a statistical method of data reduction that identifies and combines sets of dependent variables that are measuring similar thing" (Watts & Stenner, 2005). Q method employs a by-person factor analysis to identify groups of participants who Q sort a set of items in comparable ways (Watts & Stenner, 2005). Stephenson showed that the conventional factor analysis could be inverted such that it is the "n different tests or

measureable materials, not the participant group, that become the study sample…The variables are no longer hypothesized traits, but various persons who take part in the study" (Watts & Stenner, 2005, p. 71-72). Consequently, it is also persons, not traits or variables, who load on the emergent factors of an inverted factor analysis in a Q study (Watts & Stenner, 2005). Q methodology consistently supports the reflective perspective of the subjects and insight to understanding the concepts of a research topic, and provides an alternative to questionnaires and scales currently used in many exploratory studies (Lindon, 1985).

The Likert Scale, developed by Rensis Likert, is a common method for measuring attitude or opinion (Cross, 2005). This method asks participants to rate, on a scale, the extent of their agreement or disagreement with a set of statements to obtain a score representative of the participant's opinion (Cross, 2005). When using self-reporting measures such as the Likert Scale, it is not always possible to gather data in an unobtrusive manner. There is increased opportunity for the participants' answers to be influenced by knowing they are under investigation and may modify their responses (Cross, 2005).

In contrast, Q methodology is a means of revealing subjectivity involved in any situation since there is no expectation of a right or wrong way to express one's perspective. (Cross, 2005). Q methodology does not predetermine what is considered an appropriate response and the interpretation of the data emerges from the way in which participants sort the statements (Brown, 1996). Because interpretation by the researcher occurs after the sorting process, each Q statement has no significance apart from the meaning given to it by the participant. Additionally, the significance of the participants'

frame of reference supersedes any bias by the researcher (Smith, 2000). The aim of Q methodology is not to identify prevalent statistically significant viewpoints but rather to explore a complex problem from the participant's point of view—it is not a test of difference (Donner, 2001; Watts & Stenner, 2012; Owusu-Bempah, 2014). Q method allows researchers to understand why and how people believe in what they do by helping researchers answer subjective and objective research questions, and measure participants' perspectives. Q methodology provides a robust method for studying the specific viewpoints of specific people and groups (Danielson, 2009; Watts & Stenner, 2012). Q methodology "allows the main or majority viewpoints to be identified relative to a particular subject matter and for these knowledge structures to be rendered empirically observable" (Watts and Stenner, 2012, p. 46).

Watts & Stenner (2012) indicate that Q methodology does not need a large participant count to assure construct validity as it "generally aims only to establish the existence of particular viewpoints and thereafter understand, explicate and compare them" (p. 72). Furthermore, McKeown and Thomas (2013) indicate that the concept of validity is not necessarily significant in Q methodology for similar reasons. "Since Q sorts are anchored in self-reference, there is no external standard against which they can be compared to estimate their *validity* (McKeown & Thomas, 2013, p. 64). However, Maxwell (1992) established five categories of understanding in qualitative research that correspond to five types of validity that were addressed in this study. Influenced by others' work, the five types of validity include

- descriptive validity- ability to account for factual accuracy of a participant's account

- interpretive validity- concern for meaning of objects, events, and behaviors to participants
- theoretical validity- participant's ability to explain, describe and interpret the phenomena
- generalizability- ability to extend the results to other persons in similar situations
- evaluative validity- ability to describe and understand the data without being evaluative or judgmental (Maxwell, 1992).

For this study, I adopted the qualitative approach by using a pre-sort survey and a post-sort interview to support the interpretation of the quantitative factor analysis in Q. Additionally, I addressed descriptive and construct validity by using consistent qualitative pre-sort surveys and post-sort interviews to acquire additional information regarding the participants sorting experience. According to Patton (2002), generalizability validity is not significant in Q methodology and was not addressed. I addressed interpretive validity through my acknowledgement of bias and assumptions towards participant perceptions.

Instrument Development

Contrary to traditional quantitative studies, the participants were not the focus of Q method, rather the focus was on the *constructions* developed through participant self-reference (Stainton-Rogers, 1995). In other words, the most important sample in this Q methodology study was not the person(s) or *N*, but rather the development of the Q sample, a subset of statements that was presented to participants in the form of a Q sort—the method by which participants responded to the Q sample statements (Brown, 1993).

The Q statement development relied heavily upon the research questions as they determine the structure of the Q set and became a *condition of instruction* for the

participants, therefore guiding their sorting process (Watts & Stenner, 2005). The finalized Q set can be obtained in a number of ways or from a number of sources: reference to academic literature, literary and popular texts, formal interviews, informal discussions, or pilot studies (Watts & Stenner, 2005). For this study, the primary resource for the Q sample was a combination of reference to the academic literature and the unique observations and perspectives acquired through my experience working with the participants in the role of instructional designer. I intended for the final Q set to "justifiably claim to be *broadly representative* of the relevant opinion domain" (Watts & Stenner, 2005). My effort to structure a set of relevant statements from unique access and insight into the participants' pedagogical practices "merely organizes it from a standpoint of what appears…to be the most useful way of thinking, each theoretical standpoint bringing to light different aspects of the same items" (Brown, 1980). The result of this strategy was a Q set of 36 statements in four categories of relevance: Feelings About Formative Assessments, Formative Assessments and Technology, Feedback with Formative Assessments, and Use of Formative Assessments. The statements in the Q set are listed here.

Table 2. Statements in the Q set

Statement No.	Statement
	Overall Feelings About Formative Assessments
1	I am a content expert with a good understanding of formative assessments. (Black & Wiliam, 1998)
2	I am a content expert with a very limited understanding of formative assessments. (Black & Wiliam, 1998)

3	I understand the difference between formative and summative assessments. (Black & Wiliam, 1998)
4	I do not know the difference between formative and summative assessments. (Black & Wiliam, 1998)
5	I am aware that there are different types of formative assessments that I can use. (Black & Wiliam, 1998)
6	I am not aware that there are different types of formative assessments. (Black & Wiliam, 1998)
7	Formative assessments encourage superficial learning, or rote memory, of content. (Black & Wiliam, 1998)
8	Formative assessments foster a deeper learning of content.
9	Formative assessments should contribute to student's final course grade.
10	Formative assessments should be for practice only and not count towards student grades.
11	I am confident in my ability to formatively assess students.
12	Formative assessments don't really belong in medical education.
13	Formative assessments are useful in any instructional environment.
	Formative Assessments and Technology
14	I often use educational technology to implement formative assessments.
15	I am not aware of how educational technology can enhance implementation of formative assessments.
16	I always use clickers to formatively assess students during class.
17	I rarely or never use clickers during instruction.
18	I use computer-based software during instruction to implement formative assessments.
19	I don't use computer-based software assessments during instruction because it takes away from my teaching time.

20	I am aware of the best practices for using clickers in class. (Caldwell, 2007)
21	I did not know that there were any recommended best practices for clicker use. (Caldwell, 2007)
	Feedback with Formative Assessments
22	I always know the purpose behind implementing formative assessments in my class.
23	I never plan in class assessments; I do them on the fly when needed.
24	I enjoy implementing new teaching methods before others have. (Caldwell, 2007)
25	I let others implement new teaching methods before I try them. (Caldwell, 2007)
26	I am aware of the best practices associated with implementing formative assessments.
27	I am not aware of the best practices associated with implementing formative assessments.
28	I enjoy using frequent classroom questioning to assess student progress.
29	Formative assessments are a good use of instructional time.
30	I don't know enough about formative assessments to know if I am using them correctly or not.
31	I regularly provide feedback to students when I use formative assessments during instruction.
-	***Use of formative Assessments***
32	I rely on the technology to provide the feedback to students to save time during instruction.
33	I don't feel that formative assessments provide useful information.

34	I don't really know what to do with the results of formative assessments.
35	I use the results of formative assessments to give feedback to students.
36	I think formative assessments should only be used outside of class so I can maximize my teaching time.

Participants

In Q methodology, the person sample, or P-set, is the term used to describe the group of participants asked to conduct a Q sort. Participant selection in Q methodology requires strategic selection of those who demonstrate theoretical salience rather than random selection (Wright, 2013: Yang & Montgomery, 2013), and the number of participants is of relatively little importance (Brown, 2014). "Q methodology does not need large numbers of participants and it is not interested in *head* counts. It just needs enough participants to establish the existence of its factors" (Watts & Stenner, 2012, p. 88). Watts and Stenner (2012) recommend a minimum ratio of two Q-set items for every participant or a Q-set that has twice as many items than participants.

For this study, the P-set consisted of full-time faculty at an undergraduate medical school and was selected based on the determination that they hold a pivotal viewpoint salient to the topic of study, formative assessments. The number of full-time faculty from which to choose at the medical school was large when I considered both biomedical and clinical faculty. However, just as the participants need not be random, the number of participants is equally unimportant since the Q set statements become the sample, not the participants (Watts & Stenner, 2012; Wright, 2013). The only requirement criteria for

participation was that the individuals held a faculty rank of one of the following at the medical school: Professor, Associate Professor, Assistant Professor. Fifty-five biomedical and clinical faculty members were contacted individually either via email or in person based on their involvement in the first two years of the curriculum. I selected 20 participants from the original 55 and attempted to achieve equal representation between biomedical and clinical faculty designations. During the Q sort experience, I collected demographic data (Table 3) that was used for interpretation of the Q sort results (Watts & Stenner, 2012). In this study, gender distribution favored males, which is atypical in education studies (DiPrete & Buchmann, 2013). The greatest number of faculty were between 41 and 60 years of age, and there was a fairly even distribution among faculty designation and faculty rank. The number of veteran faculty (more than 11 years of experience) was almost even with the number of newer faculty. English was the native language for the majority of faculty.

Table 3. Participant Demographics Distribution

Characteristic		# of Faculty
Gender	Male	12
	Female	8
Faculty Designation	Biomedical	10
	Clinical	10
Faculty Rank	Professor	6
	Associate professor	8

	Assistant professor	6
# of Years as Faculty	0-5 years	6
	6-10 years	3
	11-20 years	7
	21 + years	4
Age	21-40 years	6
	41-60 years	10
	61-80 years	4
Race/Ethnicity	Caucasian	14
	Asian	3
	Native American	3
Native Language	English	18
	Non-English	2

Literature shows that researchers collect demographic data in order to describe the sample of participants in their studies as they generally only study a sample of a particular population (Hammer, 2011; Connelly, 2013). Researchers expect readers of research to use the demographic data to get a sense of what is known about the larger population (Connelly, 2013). Qualitative researchers use demographic data to "demonstrate the participant's appropriateness for the study" (Connelly, 2013, p. 269). However, for this study, the demographic data was collected to allow the researcher to examine the population specifically chosen for this study through purposeful selection.

Procedures and Analysis

Once approval to conduct the study was received, I collected data three different ways: Q sorts, demographic questionnaires with a pre-sort survey and post-sort interviews.

Demographic data- Each participant completed a demographic questionnaire (Appendix D) prior to their sorting experience.

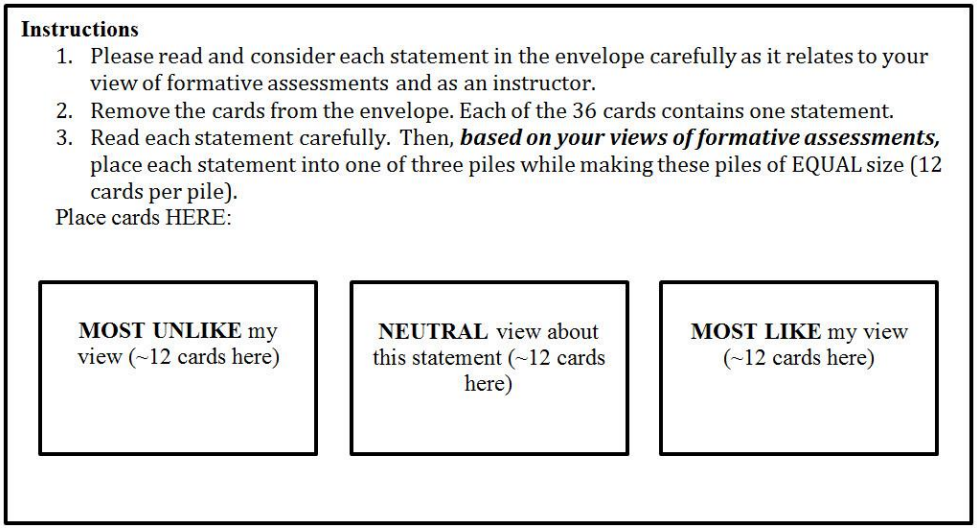
Pre-Sort Survey data- A 3 open-ended question survey was attached to the demographics questionnaire that was competed by participants prior to the sorting experience. (Appendix D).

Post-Sort Interview data- Upon completion of the sorting experience, each participant engaged in a post-sort interview regarding their sorting experience (Appendix G).

For this study, I instructed participants to interpret the statements as a full-time faculty member exposed to formative assessments in a variety of ways within their institution. First, a demographic questionnaire with a pre-sort survey was administered to gather information that was used to interpret the participants' sorting responses (Watts & Stenner, 2012). Specifically, the questionnaire and survey collected information about the participant's gender, age, work history, content specialty, degree status, and everyday technology use. Second, the participants read the statements and then pre-sorted them into three categories: Most Unlike Me, Neutral, and Most Like Me. The directions and procedures were provided to ensure all participants used the same condition of

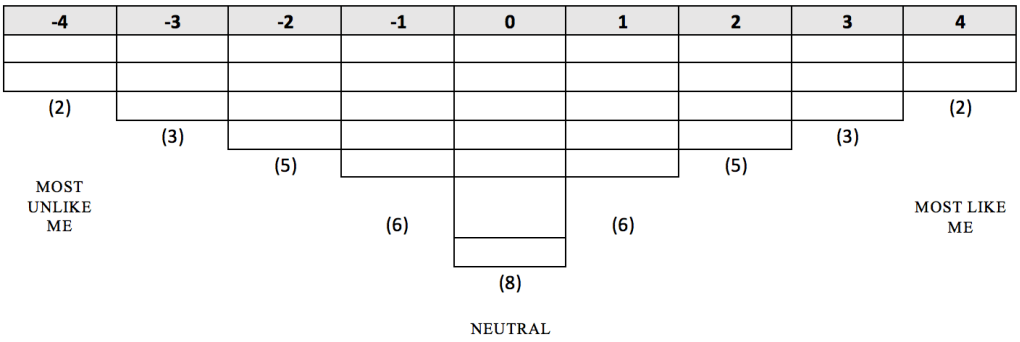
instruction: “How do I feel about the use of formative assessments”. The instructions for the pre-sort given to each participant are shown in Figure 1.

Figure 1. Instructions for ‘How do I feel about the use of formative assessments Q pre-sort’



Lastly, I asked the participants to conduct a more refined sort by ranking the two *Most Like Me* statements into the far-right-most column (+4) on the grid, followed by placing the two *Most Unlike Me* statements into the far most-left column (-4) on the grid. They were instructed to continue sorting the statements by filling the grid from the outer columns towards the middle. Figure 2 below represents the Q sort grid.

Figure 2. Illustration of a near-normal fixed (-4 to +4) distribution designed for use with 40-item Q set.



Once participants' assignment of statements was complete, I asked them to review, adjust, and finalize their sort. By forcing the participants to sort the statements according to the pre-determined grid, the number of items that could be placed in each category was limited. This process purposefully discriminates among the responses by forcing participants to make 'explicit' choices about each statement, unlike Likert scales or surveys (Dennis, 1986, Corr, 2001, McKeown & Thomas, 201). This process forced the participant to make choices about which statements do and do not reflect their views. From the Q sort, a clear configuration of statements emerged (Watts & Stenner, 2005). Once the participants were satisfied with their sort, I recorded the grid configuration.

I followed up each Q sort with a short interview that allowed participants to share their sorting experience, especially in regards to sorting at the extremes. The interview explored "each participant's wider understanding of the issue, to discover why they have sorted the items the way they have and to get them to focus on the meaning and significance of particularly important salient items" (Watts and Stenner, 2012, p. 82). A copy of the follow-up interview questions is provided in Appendix G.

The Q Sort

As mentioned previously, the data was collected through Q sorts, demographic questionnaire and pre-sort survey, and post-sort- interviews. A maximum of 20 participants was accepted. The Q sort statements were printed on index cards that mimicked the size and shape of the spaces of the sorting grid drawn onto a poster board. Sample copies of the Q sort grid and statements, demographics questionnaire and pre-sort survey, post-sort interview, and participant permission form is provided in the Appendix.

Data Analysis

Participants used the Q sorting board illustrated in Figure 2 which forced their sorts into a symmetrical, normal distribution (Watts & Stenner, 2012). I entered the participants' sorting results into computer software created specifically to analyze Q sorts. PQMethod software (Schmolk, 2014) was used to analyze the 20 Q sorts. PQMethod is a dedicated Q methodology software package that performs correlation and factor analyses of the Q sorts (Schmolck & Atkinson, 2001). "This software package provides a variety of outputs, such as a correlation matrix, factor loadings, distinguishing statements, and consensus statements" (Hollingswoth, 2013, p.67-68).

Table 4. Definition of Terms Related to Q Methodology

Correlation matrix	Indicates the intercorrelation of each Q sort with every other Q sort
Factors	Discernable patterns of commonalities or consensus among viewpoints of a group of participants
Factor loadings	Unit of measurement of a person in the context of his or her viewpoint (ex: high factor loading = person most agreeable with the view of the factor)
Confounded factors	Q sorts with high factor loadings in relation to more than one factor

Twenty valid Q sorts were entered into PQMethod for analysis. A correlation matrix was generated with each Q sort that correlated with all other sorts (Yang & Montgomery, 2013). The correlation matrix identified the correlations between individual faculty perception of formative assessment and implementation practices. The correlation matrix was then submitted for centroid factor analysis and was further

simplified using varimax rotation. Varimax rotation was appropriate for this exploratory study because it automatically seeks the mathematically superior solution that accounts for as much variability as possible in the correlations (Brown, 1980; Watts & Stenner, 2005). After examination of the three, four, and five-array-group solutions, a four-array-group solution was retained based on explained variance, and array group loadings. A table of

The first step in the data analysis process was to determine correlations among all pairs of Q sorts performed in the study. Analysis of all the participants' factor loadings combined indicated the extent to which their Q sorts vary or coincide (McKeown & Thomas, 2013). After determining the general characteristics of the factors, I looked for "groups of Q sorts, which, on the basis of their correlations, appear to go together as a group, or type" (Brown, 1980, p. 207). The factor analysis demonstrated the "statistical means by which respondents are grouped- or, more accurately, group themselves- through the process of Q sorting" (McKeown & Thomas, 2013, p. 51). The identification of the differences among the Q sorts resulted in the creation of factors. The factor analysis was applied to the results of the sorts, and defined any emergent patterns (Collins, 2009). The purpose of the factor analysis was to reveal the salient factors that most accurately reflected a common viewpoint of the sorters (Reid, 1999).

The Pilot Study

A pilot study was conducted prior to the research study to test the logistical aspects of participant access to the Q sort, delivery of the Q sort, and each of the data collection methods. Because the data or results from my pilot study would in no way be

used or referenced in the primary study, IRB approval to conduct the pilot study was not needed. The pilot study was conducted with 4 full-time Nursing School faculty at a neighboring institution. These participants followed the same protocol as those in the primary study and it was an invaluable experience prior to conducting the primary study. Several grammatical and logistical issues were discovered and corrected as well as validation of the appropriateness of the statements before conducting the primary study.

This chapter provided an overview of the methods used for the research design and analysis in this study. Specific sections discussed the Q sample, person samples, and the data collection procedures. Finally, the process of conducting a pilot study for experience was explained.

CHAPTER IV

FINDINGS

The purpose of this study was to examine faculty perceptions of formative assessments and the relationship those perceptions have with faculty implementation practices and student outcomes. I have proposed that the way in which faculty perceive the use or importance of formative assessment contributes to success or failure in implementation of the assessment within the instructional process. Therefore, Q methodology was used in this study in the following way: the Q set was developed through references to the literature as well as my personal insight from working with the faculty as an instructional designer. A pilot study was conducted to gain experience conducting a Q method study with factor analysis and to determine the validity of the Q set. In the real study, the Q sorts were analyzed using factor extraction, correlation, and factor analysis with rotation, and z-score calculation. Finally, the data was interpreted using the demographic questionnaire and pre-sort survey results and post-sort interview data. Below, the findings for the analysis process described are presented.

Development of the Q Set

For this study, I initially referred to the Dundee Ready Education Environment Measure (DREEM), which addresses student perception of their educational environment (Roff et. al., 1997), as a validated model for construction of the Q set for this study. By referencing the academic literature and using my unique observations and perspectives acquired from working with the faculty as an instructional designer, the measure was modified to develop a Q set that would address faculty perception of formative assessment. The statements in the Q set are listed in Table 2.

Table 2. Statements in the Q set

Statement No.	Statement
	Overall Feelings About Formative Assessments
1	I am a content expert with a good understanding of formative assessments. (Black & Wiliam, 1998)
2	I am a content expert with a very limited understanding of formative assessments. (Black & Wiliam, 1998)
3	I understand the difference between formative and summative assessments. (Black & Wiliam, 1998)
4	I do not know the difference between formative and summative assessments. (Black & Wiliam, 1998)
5	I am aware that there are different types of formative assessments that I can use. (Black & Wiliam, 1998)
6	I am not aware that there are different types of formative assessments. (Black & Wiliam, 1998)
7	Formative assessments encourage superficial learning, or rote memory, of content. (Black & Wiliam, 1998)

8	Formative assessments foster a deeper learning of content.
9	Formative assessments should contribute to student's final course grade.
10	Formative assessments should be for practice only and not count towards student grades.
11	I am confident in my ability to formatively assess students.
12	Formative assessments don't really belong in medical education.
13	Formative assessments are useful in any instructional environment.
	Formative Assessments and Technology
14	I often use educational technology to implement formative assessments.
15	I am not aware of how educational technology can enhance implementation of formative assessments.
16	I always use clickers to formatively assess students during class.
17	I rarely or never use clickers during instruction.
18	I use computer-based software during instruction to implement formative assessments.
19	I don't use computer-based software assessments during instruction because it takes away from my teaching time.
20	I am aware of the best practices for using clickers in class. (Caldwell, 2007)
21	I did not know that there were any recommended best practices for clicker use. (Caldwell, 2007)
	Feedback with Formative Assessments
22	I always know the purpose behind implementing formative assessments in my class.
23	I never plan in class assessments; I do them on the fly when needed.

24	I enjoy implementing new teaching methods before others have. (Caldwell, 2007)
25	I let others implement new teaching methods before I try them. (Caldwell, 2007)
26	I am aware of the best practices associated with implementing formative assessments.
27	I am not aware of the best practices associated with implementing formative assessments.
28	I enjoy using frequent classroom questioning to assess student progress.
29	Formative assessments are a good use of instructional time.
30	I don't know enough about formative assessments to know if I am using them correctly or not.
31	I regularly provide feedback to students when I use formative assessments during instruction.
-	***Use of formative Assessments***
32	I rely on the technology to provide the feedback to students to save time during instruction.
33	I don't feel that formative assessments provide useful information.
34	I don't really know what to do with the results of formative assessments.
35	I use the results of formative assessments to give feedback to students.
36	I think formative assessments should only be used outside of class so I can maximize my teaching time.

Analysis of Q Sorts

In a Q methodology study, factors are groups of Q sorts with similar viewpoints or opinions about a topic. The operant factors are extracted through a statistical process that identifies pattern similarity in the Q sorts (Watts & Stenner, 2012). The objective, statistical analysis of the subjective Q sorts, includes the following stages (or phases): 1) Calculation of the correlation matrix, or correlation of the sorts, 2) factor analysis which consists of factor loading and rotation, 3) calculation of factor scores and difference scores (z-scores), and finally 4) factor interpretation (Van Exel & Graaf, 2005).

Step 1 in the Q sort analysis, correlation of the sorts, involved comparing each individual sort with all other sorts, resulting in a correlation matrix. “This represents the level of (dis)agreement between the individual sorts, that is, the degree of (dis)similarity in points of view between the individual Q sorters" (Van Exel & Graaf, 2005). The correlation matrix (Table 5) reflects the extent of the relationships which exist between each sort with every other sort in the study (Watts & Stenner, 2005).

Table 5. Correlation matrix Between Sorts

Sorts		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	32BM46CE	1.00	0.45	0.68	0.80	0.45	0.32	0.11	0.17	0.33	0.35	0.28	0.32	0.45	0.26	0.11	0.11	0.23	0.29	0.40	0.49
2	42BM63CE	0.45	1.00	0.31	0.62	0.66	-0.90	0.36	0.61	0.77	0.78	0.76	0.58	0.61	0.50	0.60	0.20	-0.14	0.19	0.53	0.35
3	32BF60CE	0.68	0.31	1.00	-0.18	0.15	0.28	-0.26	0.11	0.11	0.15	0.14	0.39	0.28	0.35	0.22	0.18	0.14	0.24	-0.10	0.51
4	32BF562N	0.80	0.62	-0.18	1.00	0.63	-0.49	0.67	0.62	0.76	0.71	0.71	0.18	0.48	-0.33	0.50	-0.26	-0.28	-0.14	0.61	-0.14
5	32BM60CE	0.45	0.66	0.15	0.63	1.00	-0.30	0.63	0.77	0.82	0.83	0.74	0.29	0.61	-0.10	0.63	-0.80	-0.22	-0.20	0.48	0.3
6	13BM49CE	0.32	-0.90	0.28	-0.49	-0.30	1.00	-0.40	-0.42	-0.39	-0.30	-0.42	0.31	0.12	0.51	-0.29	0.55	0.64	0.52	-0.40	0.64
7	31BM544E	0.11	0.36	-0.26	0.67	0.63	-0.44	1.00	0.45	0.54	0.54	0.55	-0.90	0.41	-0.48	0.27	-0.19	-0.33	-0.21	0.46	-0.30
8	41BM65CE	0.17	0.61	0.11	0.62	0.77	-0.42	0.45	1.00	0.77	0.77	0.66	0.34	0.39	-0.10	0.72	-0.20	-0.23	-0.50	0.53	-0.60
9	22BM53CN	0.33	0.77	0.11	0.76	0.82	-0.39	0.54	0.77	1.00	0.87	0.79	0.32	0.52	-0.12	0.67	-0.25	-0.30	-0.40	0.42	-0.70
10	41BN68CE	0.35	0.78	0.15	0.71	0.83	-0.30	0.54	0.77	0.87	1.00	0.76	0.36	0.55	0.80	0.60	-0.10	-0.24	0.40	0.55	0.30
11	13CM35CE	0.28	0.76	0.14	0.71	0.74	-0.42	0.55	0.66	0.79	0.76	1.00	0.18	0.44	-0.17	0.61	-0.14	-0.32	-0.30	0.50	0.50
12	22CF372E	0.32	0.58	0.39	0.18	0.29	0.31	-0.90	0.34	0.32	0.36	0.18	1.00	0.57	0.35	0.35	0.24	0.42	0.54	0.39	0.52
13	21CF434E	0.45	0.61	0.28	0.48	0.61	0.12	0.41	0.39	0.52	0.55	0.44	0.57	1.00	0.23	0.43	0.17	0.10	0.23	0.60	0.40
14	41CF59CE	0.26	0.50	0.35	-0.33	-0.10	0.51	-0.48	-0.10	-0.12	0.80	-0.17	0.35	0.23	1.00	-0.20	0.56	0.46	0.33	-0.20	0.48
15	32CF614E	0.11	0.60	0.22	0.50	0.63	-0.29	0.27	0.72	0.67	0.60	0.61	0.35	0.43	-0.20	1.00	-0.20	-0.20	-0.20	0.39	0.20
16	13CF342E	0.11	0.20	0.18	-0.26	-0.80	0.55	-0.19	-0.20	-0.25	-0.10	-0.14	0.24	0.17	0.56	-0.20	1.00	0.44	0.46	0.36	0.55
17	13CN37CE	0.23	-0.14	0.14	-0.28	-0.22	0.64	-0.33	-0.23	-0.30	-0.24	-0.32	0.42	0.00	0.46	-0.20	0.40	1.00	0.54	0.90	0.49
18	13CN50CE	0.29	0.19	0.24	-0.14	-0.20	0.52	-0.21	-0.50	-0.40	0.40	-0.30	0.54	0.23	0.33	-0.20	0.46	0.54	1.00	0.24	0.45
19	31CM38CE	0.40	0.53	-0.10	0.61	0.48	-0.40	0.46	0.53	0.42	0.55	0.52	0.39	0.60	-0.20	0.39	0.36	0.90	0.24	1.00	0.30
20	13CF36CE	0.49	0.35	0.51	-0.14	0.30	0.64	-0.30	-0.60	-0.70	0.30	0.50	0.52	0.40	0.48	0.20	0.55	0.49	0.45	0.30	1.00

For example, you can see that Q sort 1 has its strongest relationship with Q sort 3 (0.68), Q sort 17 has no relationship with Q sort 13 (their correlation is zero), and Q sort 4 an 6 have a negative correlation.

Next, the correlation matrix was factor analyzed which offered information to suggest there were similarities among sorts with considerable variance between the factors. The factor analysis reveals how many basically different Q sorts there are (Brown, 1993). "The number of factors is therefore purely empirical and wholly dependent on how the Q sorters actually performed" (Brown, 1993, p. 111). Additionally, factor analysis identified a factor solution which accounted for the greatest number of differing sorts. Therefore, I used centroid factor analysis and varimax rotation of four factors to generate the final solution. This solution determined the grouped participants' perspectives of formative assessments. Following an examination of the loadings of all sorts on each factor, a significant factor loading was used to identify which factors were appropriate for this study. I calculated a significant factor loading at the $p < .01$ level using the following equation (Watts & Stenner, 2012):

2.58 (*SE)* x (1/√No. of items in Q Set ---(36 for this study)).

Hence, 2.58 *SE* = 2.58 x (1√36) = 0.43 ($p<.01$).

Table 5 contains the factor solution for this study. In order to account for confounded loadings, Q sorts that possess a significant factor loading in relation to more than one of the factors, it is preferable for the sorts to achieve significance on only one factor (Watts & Stenner, 2012). As mentioned previously, I retained a four-array-group solution based

on explained variance and array group loadings. Flagging of the defining sorts in Table 5 was used to determine the significant factor loadings for each sort on each factor. Using the significant factor loading > 0.43, I determined that the following sorts were significant, had high factor loadings, for each of the 4 factors: Factor 1-Sorts 2, 5, 8, 9, 10, 11, 13, 15; Factor 2- Sorts 6, 12, 14, 16, 17, 18, 20; Factor 3- Sort 7; Factor 4-Sorts 1, 3. The loadings in Table 6 were then used to determine which participants' qualitative data should be used to interpret each factor. Each factor represents a group of participants that demonstrate similar viewpoints regarding formative assessment.

Table 6. Factor Loadings Indicating a Defining Sort

Q Sorter	Factor-Group 1	Factor-Group 2	Factor-Group 3	Factor-Group 4
2	**0.76X**	0.17	0.21	0.31
5	**0.86X**	-0.05	0.15	0.19
8	**0.92X**	-0.01	-0.11	-0.14
9	**0.89X**	-0.17	0.11	0.16
10	**0.90X**	0.00	0.11	0.14
11	**0.80X**	-0.16	0.22	0.16
13	**0.55X**	0.37	0.36	0.28
15	**0.73X**	-0.02	-0.03	0.03
6	-0.39	**0.73X**	-0.02	0.27
12	0.40	**0.58X**	0.03	0.17
14	0.00	**0.61X**	-0.35	0.14
16	-0.02	**0.70X**	-0.08	-0.07
17	-0.26	**0.73X**	0.01	0.05
18	0.01	**0.67X**	0.02	0.11
20	0.02	**0.71X**	0.06	0.42
1	0.25	0.24	0.05	**0.88X**
3	0.17	0.30	-0.34	**0.60X**
4	***0.72***	0.22	***0.48***	-0.10
7	***0.49***	-0.34	***0.59X***	-0.03
19	***0.57***	0.40	***0.56***	-0.25
No. of Defining Sorts	8	7	1	2

Note: Factor loading > .43 are in bold type, X indicates defining sorts, and italics indicated confounded sorts.

In step 3, I used PQMethod to calculate the factor scores for each statement within each factor (Schmolck, 2014). The weighted factor scores with corresponding ranks offer a first glimpse of a factor's overall viewpoint. However, the weighted scores do not allow for *cross-factor* comparisons to be made because the number of Q sorts that contribute to the totals in each case are different (Watts & Stenner, 2012). Therefore, to permit *cross-factor* comparisons, the total scores were converted into z (or standard) scores—normalized factor scores—which show the ranking of each sort compared across the factors (Watts & Stenner, 2012). The factors were converted for each item into a single factor array, a single Q sort that is configured to represent the overall perception or viewpoint of a factor (Watts & Stenner, 2012). These factor arrays provide the basis for interpretation through careful inspection of the patterns of the items in the arrays in order to discover the perceptions of the exemplar factors—factors that have a minimum of one Q sort on which it loads significantly (Stenner, Cooper, & Skevington, 2003). Factor arrays provided the basis for factor interpretation (Watts & Stenner, 2012). The arrays for the 4 factors in this study, z-scores included, can be found in Appendix E.

Factor Interpretation

The final step of the statistical analysis of the Q sorts is the interpretation of the factors. With the factor arrays established, the transition from arrays to interpretation took place. The aim of factor interpretation is to discover, understand, and explain the captured viewpoints and the significant loadings participants shared within a factor (Watts & Stenner, 2012). The interrelationship of the items within each factor array

drives the interpretation of the factor, which highlights the holistic nature of the process (Watts & Stenner, 2012).

Factor interpretation in this study began with creating what Watts and Stenner (2012) refer to as a "crib sheet" in order to examine the placement of statements in each factor according to the factor (z) scores, with specific interest in the extreme placements of "Most Like Me" and "Most Unlike Me". The crib sheet "provides a wider system of organization for the interpretative process and encourages holism by forcing engagement with every *item* in a factor array" (Watts & Stenner, 2012, p. 152; Stenner, Cooper, & Skevington, 2003). The crib sheets for each factor can be found in Appendix F.

Development of themes focused on discovering the similarities and differences between factors based on consensus and differentiating statements, demographic, pre-sort survey results and post-sort interview data. The goal was to identify what differences existed between the participants in order to generate a unique, defining perspective for each factor. This process enabled a holistic interpretation of each factor and the generation of appropriate factor summaries, and as a result, naming each factor. These factors were found to represent four distinct, but related, perspectives of formative assessment.

The holistic nature of factor interpretation in Q methodology requires multiple stages of data collection and analysis. After reflection on the statistical data from factor extraction and rotation, I analyzed the qualitative data in order to employ a holistic process: initial naming of factors, analysis of statement placement, and demographic and interview data (Watts & Stenner, 2012). I analyzed the data provided by the PQMethod software to determine themes between and across the factors. By looking at the

standardized factor scores (z scores) with corresponding ranks for each Q set item, I determined how often statements were sorted as "Most Like me" and "Most Unlike Me" for each factor group. From this information, I constructed themes between and across the factors. Then I used the demographic questionnaire data, pre-sort survey results, and post-sort interview data to triangulate and support the determined themes. Additionally, I created and examined the factor arrays and determined identifiable predominant themes.

Factor Naming, Initial Stage- Initially, I named each factor according to what seemed intuitively clear across the factors. The naming process occurred based on a full analysis of the data. I assigned an initial name to each factor that represented the faculty designation—biomedical or clinical—based on identification of the individuals who loaded on each factor. This enabled me to have an initial understanding of the meaning of how the participants sorted compared to the other factor arrays because of my unique working relationship with the faculty participants. I was able to immediately recognize that faculty designation heavily influenced perception of formative assessment. Therefore, in the initial naming process I called Factor 1 *Biomedical-Familiar with Formative Assessment.* The pre-sort survey and post-sort interview data supported these participants were likely more informed about formative assessment. I called Factor 2 *Clinical-Unfamiliar with Formative Assessment.* Supporting evidence for this came from their sorts as well as their interviews, indicating they were very unfamiliar and thus uncomfortable with formative assessments. Factors 3 and 4 were more difficult to name initially, especially from the factor loadings alone, but once I analyzed the interview data, their perspectives became clearer. I named Factor 3 *Gross Anatomy- Formative Assessment must be purposeful and planned.* Only one participant loaded on Factor 3,

and the factor array indicated many similarities to Factor 1. However, there were differences that distinguished between the two factors. I called Factor 4 *Biomedical-Familiar with Formative Assessment but not my style.* In this initial naming stage, it became clear that there were some shared perspectives across all of the factors, but also that distinct knowledge levels and opinions towards formative assessment affected the participants' perception of formative assessments as a whole. The statements that did not show significant difference among the factor arrays and z-scores were considered consensus statements and therefore interpreted as common perspectives among the participants.

Consensus Statements

Analysis of the factor arrays supports four divergent perspectives on formative assessment and showed several common themes based on array location and z-scores (Table 7). Consensus statements are considered non-significant because they do not distinguish between any pairs of factors (Schmolck, 2014). There were only two consensus statements across all four factors, one positive and one negative, demonstrated by the z-scores (Table 7).

Table 7. Consensus Statements

		Factor 1		Factor 2		Factor 3		Factor 4	
No.	Statement	array	Z-score	array	Z-score	array	Z-score	array	Z-score
10	Formative assessments should be for practice only and not count towards student grades.	-1	-0.6	-1	-0.31	1	0.46	-1	-0.27
28	I enjoy using frequent classroom questioning to assess student progress.	4	1.72	2	1.22	2	0.91	3	1.44

Note. All listed statements are Non-Significant at P> .01.

Statements landing in similar array positions with similar z-scores are represented in Table 6. All participants felt using frequent classroom questioning to assess students was enjoyable (statement 28). This position is not surprising as both clinical and biomedical faculty are invested in student learning.

Although there was agreement by participants that frequently asking questions in the classroom helps the students' learning process, all but one of the groups also disagreed with the sentiment that "Formative assessments should be for practice only and not count towards student grade" (statement 10). With the array positions for this statement ranging from 1 to -1 across the factors, it seems that the participants held a somewhat disinterested or neutral stance on this perspective.

After analyzing the participants' Q sorts, I then analyzed demographic, pre-sort survey and post-sort interview data. I then identified themes used to help describe the uniqueness of each factor.

Themes- Analysis of the data provided information that supported the development of themes for each factor that applied to each one uniquely: Factor 1 were

familiar with formative assessments and were likely early adopters of assessment methods. Factor 2 were unfamiliar with formative assessment, almost to an extreme, and felt inept in their responses regarding formative assessment. Factor 3 was familiar with formative assessment, but indifferent about being the trailblazer or uninfluenced by what others did, thus very particular with formative assessment. Factor 4 were also familiar with formative assessment, but did not necessarily feel the proof for their usefulness was strong enough for them to use them. These initial themes were used to support the analysis and interpretation of the factors. Following the interpretation of the factors, I renamed the themes to more appropriately reflect the results of the factor analysis and interpretation. The new themes were renamed to *Confident Users, Unfamiliar Supporters, Purposeful User, and Cautious Users*.

Factor 1: Confident Users

Confident Users. Seven male and three female participants defined this group. All sorters in this group were over the age of 30, three were younger than 45, two were over 50, and five were over 60. Six held the biomedical faculty designation while four were categorized as clinical. One had less than 5-years of experience as a faculty member, two had 6 to 10-years, four had 11 to 20-years, and three had more than 21-years of experience as faculty. All participants were professors with faculty rank and held either a Ph.D. or a D.O. degree. Four were full professors, five were associate professors and one was an assistant professor. Seven sorters identified as Caucasian, one as Asian, and two as Native American. All but two indicated English as their native language.

These faculty strongly agreed that they use technology to teach and to facilitate learning activities. Additionally, there was consensus among the group that lack of time

to learn the use and integration of technology for formative assessment was the greatest barrier to implementing formative assessments. Table 7 shows the array configuration and z-scores for the top 10 statements sorted by this group as “Most Like me” and the top 10 statements sorted as “Most Unlike Me”. A complete factor array for this group can be found in Appendix E.

Statements that are found to be statistically significant are considered distinguishing statements. These statements exceed the difference scores between factors, and reflect where participants have sorted statements in a statistically significantly different position than the sorters on the other factors (Gallagher & Porock, 2010). Distinguishing statements also provide awareness for factor interpretation through comparisons and contrasts between positioning of items, resulting in grouping participants instead of statements (Gallagher & Porock, 2010). Therefore, distinguishing statements help describe group loadings on a particular factor. For this study, I used the z-scores for between-factor interpretation (Table 8).

Table 8. Highest Positive and Negative Ranking Statements for Confident Users

No.	"Most Like Me" Statements	Array Pos.	Z-Score
28	I enjoy using frequent classroom questioning to assess student progress.	4	1.716
29	Formative assessments are a good use of instructional time.	4	1.665
18	I use computer-based software during instruction to implement formative assessments.	3	1.248
14	I often use educational technology to implement formative assessments.	3	1.245
8	Formative assessments foster a deeper learning of content.	3	1.124

35	I use the results of formative assessments to give feedback to students.	2	1.048
31	I regularly provide feedback to students when I use formative assessments during instruction.	2	0.989
5	I am aware that there are different types of formative assessments that I can use.	2	0.944
22	I always know the purpose behind implementing formative assessments in my class	2	0.911
13	Formative assessments are useful in any instructional environment.	2	0.885

No.	"Most Unlike Me" Statements	Array Position	Z-Score
6	I am not aware that there are different types of formative assessments.	-2	-0.641
15	I am not aware of how educational technology can enhance implementation of formative assessments.	-2	-0.813
7	Formative assessments encourage superficial learning, or rote memory, of content.	-2	-0.988
4	I do not know the difference between formative and summative assessments.	-2	-1.037
19	I don't use computer-based software assessments during instruction because it takes away from my teaching time.	-2	-1.135
36	I think formative assessments should only be used outside of class so I can maximize my teaching time.	-3	-1.248
23	I never plan in class assessments; I do them on the fly when needed.	-3	-1.521
17	I rarely or never use clickers during instruction.	-3	-1.602
33	I don't feel that formative assessments provide useful information.	-4	-1.642

12	Formative assessments don't really belong in medical education.	-4	-1.923

Note. * indicates a distinguishing statement, p > .05

I labeled this group (factor) *Confident Users* to capture the passion this group expressed towards using formative assessments, with or without technology, and often before others. Unique to this group was their level of confidence and adamant stance on the use of formative assessments, primarily in the form of clickers. These sorters actively use technology to formatively assess students and were comfortable with learning and using technology first. (Table 9).

Table 9. Use of Technology to Formatively Assess

	No. of Sorters
Use of Technology for Instruction	
Presentation software (ppt, prezi, etc.)	10
Clicker Systems	10
Factors for Motivation in Using Technology in Teaching	
Enhancement of instruction	8
To facilitate learning activities	7

By all accounts, this group felt that formative assessments were very important to the learning process and expressed the belief that more formative assessments meant a better learning environment for the student. Additionally, sorters in this group felt strongly that that formative assessments, with or without technology, were necessary in both teaching and learning. Although this group expressed their confidence in performing formative assessments on the fly and without prior planning to make necessary changes

in instruction based on the results, they expressed that time was a distinct barrier to implementation—time to learn how to use the technology and implement the formative assessment and time to implement them within their instructional sessions in the classroom.

There were several themes within this factor that emerged through the analysis and interpretation of data. I called these themes *Awareness is Key, Technology Helps,* and *Student Outcomes Improve* to support the general summary of *Confident Users.* Data to support the themes is provided here.

Awareness is Key. This group sorted statements about the use, enjoyment of use, and awareness of formative assessments in a way that indicated a strong agreement with the relevant statements—more so than the other groups (Table 5). *Confident Users* strongly agreed on their awareness of the different types of formative assessments, and their usefulness as an instructional tool (statement 5, z-score 0.944 and statement 29, z-score 1.665). They agreed that formative assessment fosters deeper learning of content and that they should be purposefully planned (statement 8, z-score 1.124 and statement 22, z-score 0.911).

For this group, awareness of using formative assessment went beyond asking clicker questions during class. Understanding the different technologies and methods associated with their implementation practices was a key component to their self-perceived success. Awareness for this group meant having the confidence and willingness to try new methods before others, even with the challenge of time constraints.

Confident Users is an appropriate title for this group because of their perceived high levels of understanding, frequent use of formative assessment, and inclination to spearhead new methods as compared to the other groups in the study.

Responses to demographic, survey and interview data indicated that all biomedical faculty (five of the ten) considered themselves knowledgeable about formative assessment and comfortable with their use. Two of the four clinical faculty also indicated having adequate knowledge of formative assessment and the necessity of their use: one cross loaded significantly with Factor 3, and one dissented from this view. The dissenting clinical faculty in this group expressed the importance of formative assessment, yet focused on the preparation phase being too much work: "It feels like it would be too much work on the instructor…" (Pre-sort survey question no. 1).

In the post-sort interviews, the theme of awareness was supported as the biomedical faculty predominantly discussed the usefulness of formative assessment as an engagement tool, while the clinical faculty often referred to how useful they are for promoting "doctor-like" thinking by applying clinical reasoning on the fly. Sorter 11 noted: "I enjoy frequently assessing students along the way -- using frequent board style questions in lectures. Feedback is how students learn to think like doctors-allows students to learn to apply clinical reasoning. I feel like those methods work best" (Post-sort interview). The group's overall awareness of formative assessment as well as their faculty designation was likely tied to the sorters' implementation practices.

Technology Helps. *Confident Users* identified their comfort with technology, and the idea of rarely using technology to implement formative assessment was strongly rejected, as evidences by the negative position of the statement: "I rarely or never use

clickers during instructions" (statement 17, array position -3). Comfort with using different forms of technology to implement formative assessments was strongly agreed upon among the group. Examples of this agreement include: "I use computer-based software during instruction to implement formative assessments" (statement 18, array position 3) and "I often use educational technology to implement formative assessments" (statement 14, array position 3). Faculty often use technology for the sole purpose of implementing formative assessment; one sorter stated, "I do use computer-based instructional technology. I am always for educational technology. Formative assessments provide useful information-testing students in different dimensions" (Post-sort interview, sorter no.4). Additionally, there was a general consensus among this group on how technology allows for increased use of formative assessment during instruction. Sorter 15 exemplifies: "I use clickers as often as I can- to engage students to increase interest. I do use computer-based assessments within instructional time-it's all instructional time" (Post-sort interview).

A significant outcome of using formative assessment is receiving, interpreting and using the feedback. The clinical faculty in this group who indicated less comfort and knowledge with formative assessment also expressed understanding of the usefulness of formative assessment and how technology can enhance that experience. "I don't know much about this -- not trained in educational theory and teaching. I think it's important to give feedback during teaching" (Post-sort interview, sorter no. 13), and "Formative assessments are very useful-engagement, participation enhances retention of material. I use technology to assess often" (Post-sort interview sorter no. 15).

Student Outcomes Improve. *Confident Users* identified the social aspect of using formative assessment as well as their influence on student outcomes. Agreement among the group was strongly in favor of the positive effect formative assessments had on student overall performance. The placement of the statement "Formative assessments foster a deeper learning of content" (statement 8, array position 3) and the dissenting statement "Formative assessments encourage superficial learning, or rote memory, of content" (statement 7, array position -2) illustrate general agreement within the group regarding formative assessment and student learning. The name *Confident Users* reflects faculty's positive feeling towards using formative assessment in various ways. Collectively they rejected statement 36: "I think formative assessments should only be used outside of class…" (array position -3). The classroom atmosphere is appealing to this group who promote student interaction as a means of formative assessment, as indicated by sorter 10, who explained, "I like to see students interacting with each other and the process of coming up with an answer and seeing their results quickly. More interesting interaction with content…the more periodic uses of injected student evaluation or discussion, the more interesting and cohesive classroom" (Post-sort interview).

One clinical faculty member expanded on the idea of positively affecting student performance by stating "I feel students get out of it what they put into it -- again performance dictates outcomes" (Pre-sort survey, sorter no. 15). This was not a prevailing sentiment among the group, but important to mention as a unique perspective relating formative assessment to student performance.

At this medical school, faculty feel pressure to make sure students receive what they need in order to pass National Board exams. Students repeatedly make suggestions regarding how this is best achieved. Within the *Confident Users,* one clinical faculty suggested a link between formative assessment and student learning and performance, "…students say that they only want high yield information, but what they really want is to have "ALL" the information explained in a high yield way. I feel that formative assessment is the link to that" (Pre-sort survey, sorter no. 11).

An unanticipated result for this group was the placement of "I don't know enough about formative assessment to know if I am using them correctly or not" (statement 3, array position 0). The statement and its placement stands in contrast to the group's overall feelings toward formative assessment indicated by the rest of the statement placements, the survey results, and the interview data. Overall, the *Confident Users* group expressed a perception of formative assessment that relays confidence, willingness, comfort with technology, and respect for the effect formative assessment has on student outcomes. It was surprising to also discover that this group felt unsure about how they were using the formative assessments. Despite this finding, I felt that the *Confident Users* group was appropriately labeled.

Factor 2: Unfamiliar Supporters

Unfamiliar Supporters. Three male and four female participants defined this group. All sorters in this group were over the age of 30, four were younger than 40, three were over 40 and two of those were over 50. One held the biomedical faculty designation while six were categorized as clinical. Five had less than 5 years of experience as a faculty member, one had 6 to 10 years, and one had more than 21 years of experience as

faculty. All participants were professors with faculty rank and held either a M.D. or a D.O. degree. One was a full professor, one was an associate professor and five were assistant professors. Five sorters identified as Caucasian, and two as Asian. Everyone in this group indicated English as their native language.

These faculty strongly agreed that although they are content experts in their field, they are tremendously unfamiliar with formative assessments. Additionally, there was consensus among the group that lack of time to learn the use and integration of technology for formative assessment and lack of development opportunities were the greatest barriers to implementing formative assessments. Table 10 shows the array configuration and z-scores for the top 10 statements sorted by this group as “Most Like me” and the top 10 statements sorted as “Most Unlike Me”. A complete factor array for this group can be found in Appendix E.

Table 10. Highest Positive and Negative Ranking Statements for Unfamiliar Supporters

No.	"Most Like Me" Statements	Array Pos.	Z-Score
30	I don't know enough about formative assessments to know if I am using them correctly or not.	4	1.786
4	I do not know the difference between formative and summative assessments.	4	1.601
27	I am not aware of the best practices associated with implementing formative assessments.	3	1.555
6	I am not aware that there are different types of formative assessments.	3	1.513
2	I am a content expert with a very limited understanding of formative assessments	3	1.415

21	I did not know that there were any recommended best practices for clicker use.	2	1.332
28	I enjoy using frequent classroom questioning to assess student progress.	2	1.224
15	I am not aware of how educational technology can enhance implementation of formative assessments.	2	1.088
34	I don't really know what to do with the results of formative assessments.	2	0.936
24	I enjoy implementing new teaching methods before others have.	2	0.641

No.	"Most Unlike Me" Statements	Array Position	Z-Score
31	I regularly provide feedback to students when I use formative assessments during instruction.	-2	-0.574
14	I often use educational technology to implement formative assessments.	-2	-0.65
11	I am confident in my ability to formatively assess students.	-2	-0.848
23	I never plan in class assessments; I do them on the fly when needed.	-2	-0.901
12	Formative assessments don't really belong in medical education.	-2	-0.901
20	I am aware of the best practices for using clickers in class.	-3	-0.983
22	I always know the purpose behind implementing formative assessments in my class.	-3	-1.421
1	I am a content expert with a good understanding of formative assessments.	-3	-1.512
3	I understand the difference between formative and summative assessments.	-4	-1.679

26	I am aware of the best practices associated with implementing formative assessments.	-4	1.873

Note. *indicates a distinguishing statement, p >.05

The *Unfamiliar Supporters* group is primarily made up of clinical faculty, and formative assessment was clearly not a concept they felt familiar with even though they expressed value for the concept. This group disagreed that formative assessments do not belong in medical education (statement 12, array position -2) and somewhat reject that they should be for practice only (statement 10, array position -1). Despite their perceived lack of familiarity with formative assessments, this group expressed enjoyment in implementing new teaching methods (statement 24, array position 2) as well as using frequent classroom questioning (statement 28, array position 2). Sorters in this group strongly indicated that "I do not know enough about formative assessments to know if I am using them correctly or not" (statement 30, array position 4), yet their perceived lack of understanding did not affect their enjoyment, interest, or support for using formative assessments.

There were two distinct themes identified based on the statement placement, survey results and interview data. The themes were called *Inexperience Affects Implementation* and *Formative Assessments are Valuable* to support the general summary of *Unfamiliar Supporters* views. Data to support each them is provided here.

Inexperience Affects Implementation. These sorters indicated a strong sense of inexperience in terms of what formative assessments are, and how to use them. The two highest ranked statements by this group indicate this perception: "I don't know enough about formative assessments to know if I am using them correctly or not" (statement 30, array position 4) and "I do not know the difference between formative and summative

assessments" (statement 4, array position 4). One sorter explained the struggle by stating "I have very little knowledge of formative assessment, so I imagine that my implementation is poor" (Pre-sort survey, sorter no. 17). Several others indicated their insecurities with formative assessments, with these statements:

- "I do not know what formative assessment is" (Pre-sort survey, sorter no. 16),
- "I am not one to do new methods before others do, I am unfamiliar with formative assessment" (Post-sort interview, sorter no.14) and
- "I don't have a strong awareness of formative assessment, or the underlying concepts…I don't know the difference between formative and summative assessment (Post-sort interview, sorter no. 20).

These sorters indicated their unfamiliarity with formative assessments is a challenge that influences their decision to use them or not. Observational data gathered from my role as an instructional designer for these faculty supports this struggle. This group of faculty are, more often than not, off campus seeing patients and teaching in a clinical setting. Their sorting preferences and perspectives on formative assessment were tied to these experiences, in contrast to biomedical faculty from Factor 1, who have more classroom training and thus, comfort with this type of assessment.

Unfamiliar Supporters' array position of statements about formative assessments indicates a strong overall view of unawareness, inexperience, and hesitation. Prior to the sorts, members of this group consistently commented about their perceived lack of knowledge regarding formative assessment. However, after the sorting experience and follow-up interview, the members consistently desired a one-on-one discussion related to formative assessment. Several sorters discussed why they felt inadequate to sort some of the statements: "My knowledge level of formative assessment is low" (sorter no.18, comment during discussion) and "I have very little knowledge so I didn't feel qualified to

answer questions about formative assessment" (sorter no. 17, comment during discussion). These comments helped develop a more refined view of these sorters' perception of formative assessment.

Formative Assessments are Valuable. Analysis of results indicated that although these faculty lacked confidence in their understanding and use of formative assessment, they had more confidence in why formative assessments were used. These faculty somewhat agreed on the statements "Formative assessments foster a deeper learning of content" (statement 8, array position 1) and "I enjoy using frequent classroom questioning to assess student progress" (statement 28, array position 2) which was supported by, "I believe it is critical to evaluate students' understanding of the material" (Pre-sort survey, sorter no. 6). However, they also generally rejected the idea that "I never plan in class assessments; I do them on the fly when needed" (statement 23, array position -2) and "I don't feel that formative assessments provide useful information" (statement 33, array position -1) indicating they had a sense of the value in why formative assessments are used.

Although the sorters showed consensus on lack of familiarity, they also demonstrated the belief that formative assessment has a positive effect on student learning. One sorter noted, "I believe that it is helpful, especially in a medical clinical environment. It allows for the addition of factors that are difficult to measure on a test score and overall improve physician education" (Pre-sort survey, sorter no. 17) Another sorter simply stated "I think it is integral in the education of students" (Pre-sort survey, sorter no. 12) further supporting this group's awareness of 'why' despite not understanding the 'what' and 'how' of formative assessment.

Factor 3. Purposeful User

Purposeful User. This factor had only one significant loader - one male - which defined this factor. This sorter was over the age of 50 and had a biomedical faculty designation. This participant has been a faculty member for 11to 20-years and has a faculty rank of full professor.

This faculty member strongly indicated familiarity and comfort with formative assessment as well as understanding of the difference between formative and summative assessments. Additionally, this participant uses technology to teach and facilitate learning, much like the sorters in Factor 1. Table 11 shows the array configuration and z-scores for the top 10 statements sorted by this group as "Most Like me" and the top 10 statements sorted as "Most Unlike Me". A complete factor array for this group can be found in Appendix E.

Table 11. Highest Positive and Negative Ranking Statements for Purposeful User

No.	"Most Like Me" Statements	Array Pos.	Z-Score
1*	I am a content expert with a good understanding of formative assessments.	4	1.826
3*	I understand the difference between formative and summative assessments.	4	1.826
14	I often use educational technology to implement formative assessments.	3	1.369
22	I always know the purpose behind implementing formative assessments in my class.	3	1.369
31	I regularly provide feedback to students when I use formative assessments during instruction.	3	1.369
11	I am confident in my ability to formatively assess students.	2	0.913

18	I use computer-based software during instruction to implement formative assessments.	2	0.913
24	I enjoy implementing new teaching methods before others have.	2	0.913
28	I enjoy using frequent classroom questioning to assess student progress.	2	0.913
35	I use the results of formative assessments to give feedback to students.	2	0.913

No.	"Most Unlike Me" Statements	Array Position	Z-Score
12	Formative assessments don't really belong in medical education.	-2	-0.913
6	I am not aware that there are different types of formative assessments.	-2	-0.913
23	I never plan in class assessments; I do them on the fly when needed.	-2	-0.913
19	I don't use computer-based software assessments during instruction because it takes away from my teaching time.	-2	-0.913
15	I am not aware of how educational technology can enhance implementation of formative assessments.	-2	-0.913
32*	I rely on the technology to provide the feedback to students to save time during instruction.	-3	-1.369
25	I let others implement new teaching methods before I try them.	-3	-1.369
36	I think formative assessments should only be used outside of class so I can maximize my teaching time.	-3	-1.369
4	I do not know the difference between formative and summative assessments.	-4	-1.826
9*	Formative assessments should contribute to student's final course grade.	-4	-1.826

Note. *indicates a distinguishing statement, p >.05

The *Purposeful User* is clearly very confident in knowledge and understanding of formative assessment and why they are used. I labeled this group *Purposeful User* to capture the sense of pride this participant took in knowing the content, how to teach it, and being very purposeful about it. Based on the analysis of the factor, pre-sort survey and post-sort interview, there were two themes that emerged for this group (sorter). The themes were called *Confidence Drives Planning* and *Skeptical but Persistent* to support the general sense of the *Purposeful User* sort. Data to support each theme is provided here.

Confidence Drives Planning. The *Purposeful User* sort shared several similarities with Factor 1, but there were also great differences among the factors. The shared perspectives with the group in Factor 1 may be due in part to the shared faculty designation—biomedical—and experience such as, "I always use clickers to formatively assess students during class" (statement 16, array position 1) and "I often use educational technology to implement formative assessments" (statement 14, array position 3). However, unique to this group (sorter) was the confidence, purposefulness and structure with which this sorter perceives and implements formative assessment. This sorter strongly agreed with "I am a content expert with a good understanding of formative assessments" (statement, array position 4) and "I do know the difference between formative and summative assessments" (statement 3, array position 4). Additionally, this sorter strongly disagreed with "I let others implement new teaching methods before I try them" (statement 25, array position -3). This further supports the confident user this theme indicates.

Taken as a whole, the views of this factor indicate a strong preference towards using formative assessments as an early adopter and with a strong purpose in mind. This sorter agreed the statement: "I always know the purpose behind implementing formative assessment in my class" (statement 22, array position 3) and rejected the statement: "I never plan in class assessments; I do them on the fly when needed" (statement 23, array position -2). The analysis of data indicated strong feelings toward using feedback and the effect of formative assessment on students. This sorter strongly agreed with "I regularly provide feedback to students when I use formative assessments during instruction" (statement 31, array position 3). Additionally, this sorter was adamant and particular about his use of formative assessment: "Formative assessment should not be part of students' final grade, and I made this decision based on my practice" (post-sort interview, sorter no. 7).

Skeptical but Persistent. The sorter in this group strongly indicated the use of educational technology, specifically clickers, to implement formative assessment. However, although this sorter indicated purposefulness, confidence and structure with regards to perception and practice with formative assessment, the data analysis showed that there exists a skepticism amidst the sorter's certainty related to formative assessment. The statement "Formative assessments foster a deeper learning of content" had an array position of 0, indicating possible contradiction to his overall perception. This sorter strongly disagreed with "Formative assessments don't really belong in medical education" (statement 12, array position -2) indicating this is a false perception for this sorter.

This sorter also demonstrated a level of skepticism indicated in his comment "Due to the rigors of the medical program, we do not practice formative assessment for student learning. Unfortunately, we do very little to identify students' strengths and weaknesses to target areas that need work" (pre-sort survey, sorter no. 7). Additionally, this sorter stated "It is very challenging to implement formative assessment in a subject-rich environment like medical school" (pre-sort survey, sorter no. 7). Although there was a thread of suggested skepticism in the data, the perception that using formative assessments in teaching as beneficial, remained strong.

Factor 4. Cautious Users

Cautious Users. Two participants defined this group. Both sorters were over the age of 40 and both held the biomedical faculty designation. They had between 11 to 20 years of faculty experience, and had the faculty rank of associate professor with a Ph.D. degree. Both sorters identified as Caucasian with English as their native language.

These faculty strongly agreed they are familiar with formative assessment, but have experiences that influence their doubtful implementation of formative assessment and use of technology. Ironically, there was consensus among them that technology enhances the teaching process. Table 12 shows the array configuration and z-scores for the top 10 statements sorted by this group as "Most Like me" and the top 10 statements sorted as "Most Unlike Me". A complete factor array for this group can be found in Appendix E.

Table 12. Highest Positive and Negative Ranking Statements for Cautious Users

No.	"Most Like Me" Statements	Array Pos.	Z-Score
2	I am a content expert with a very limited understanding of formative assessments	4	1.922
17*	I rarely or never use clickers during instruction.	4	1.743
8	Formative assessments foster a deeper learning of content.	3	1.441
28	I enjoy using frequent classroom questioning to assess student progress.	3	1.441
29	Formative assessments are a good use of instructional time.	3	1.173
27	I am not aware of the best practices associated with implementing formative assessments.	2	1.05
34	I don't really know what to do with the results of formative assessments.	2	0.961
35	I use the results of formative assessments to give feedback to students.	2	0.961
31	I regularly provide feedback to students when I use formative assessments during instruction.	2	0.782
6*	I am not aware that there are different types of formative assessments.	2	0.693
No.	"Most Unlike Me" Statements	Array Position	Z-Score
9*	Formative assessments should contribute to student's final course grade.	-2	-0.604
26	I am aware of the best practices associated with implementing formative assessments.	-2	-0.872

14	I often use educational technology to implement formative assessments.	-2	-0.961
24*	I enjoy implementing new teaching methods before others have.	-2	-1.05
7	Formative assessments encourage superficial learning, or rote memory, of content.	-2	-1.05
33	I don't feel that formative assessments provide useful information.	-3	-1.352
36	I think formative assessments should only be used outside of class so I can maximize my teaching time.	-3	-1.352
16*	I always use clickers to formatively assess students during class.	-3	-1.53
12	Formative assessments don't really belong in medical education.	-4	-1.654
23	I never plan in class assessments; I do them on the fly when needed.	-4	-1.922

Note. *indicates a distinguishing statement, p >.05

I labeled this group *Cautious Users* to capture the spirit behind their perceptions toward using formative assessments, with or without technology. Unique to this group was their level of resistance toward using technology to implement formative assessments even though they strongly agreed "Formative assessments are a good use of instructional time" (statement 29, array position 3) and "Formative assessments foster a deeper learning of content" (statement 8, array position 3). This group indicated an awareness that formative assessment enhances learning, but they appeared ambivalent in their implementation of them. By all accounts, this group felt formative assessments are useful, but expressed a great deal of hesitancy in their willingness to use technology to

implement them. Table 13 displays the factors this group perceives as influences on their motivation to use technology to implement formative assessments.

Table 13. Factors that Influence Motivation to Formatively Assess with Technology

	No. of Sorters
Use of Technology for Instruction	
Presentation software (ppt, prezi, etc.)	2
Clicker Systems	1
Factors that Influence Motivation to Formatively Assess with Technology	
Enhancement of instruction	2
To facilitate learning activities	0

Sorters in this group felt strongly that formative assessment is necessary and fosters student learning. However, they also expressed their hesitation in using technology to do so. Analysis and interpretation of the data for this factor permitted development of two themes. The themes were called *Student Perception Matters* and *Prior Experiences Define Use*. Data to support the themes is provided here.

Student Perception Matters. This group sorted statements about formative assessment in a way that indicates a more student-centered perspective than the other groups. *Cautious Users* strongly rejected the idea that formative assessments don't provide useful information (statement 33, array position -3) and they agreed that feedback should be provided when using formative assessment during instruction (statement 31, array position 2). However, in spite of understanding that students need feedback from formative assessments to make them meaningful, the group showed

agreement that they do not really know what to do with the results of formative assessments (statement 34, array position 2).

Student perception toward formative assessments and the use of technology to administer them was the driving force behind their implementation practices. The sorters' decisions to use formative assessment were not a result of a lack of recognition of formative assessment's value, but rather their decisions were heavily influenced by student opinion and previous experiences.

Pre-sort survey results and interview data indicated that members of this group were hesitant in using technology to implement formative assessment based on student feedback from prior attempts at implementation. In response to the survey item, '*Describe your feelings and attitudes towards using formative assessments in your teaching*', one sorter commented "It is useful, mostly for students to understand/grasp what they know at a given point" (Pre-sort survey sorter no.1). This sorter understood the importance of student perception of formative assessment, however, implementing them with technology was no longer of interest. This sorter's statement, "I moved away from using clickers and I use verbal questioning now" (Post-sort interview sorter no.1), which supports this group's factor array, indicating strong agreement with "I rarely or never use clickers during instruction" (statement 17, array position 4). This sorter lacked confidence that his perceived knowledge of formative assessment had any influence on his implementation, but he believes students should appreciate how much they understand (Pre-sort survey, questions no. 2). Additionally, differentiating between particular content was an influential factor in their use of formative assessments. A sorter in *Cautious Users* explained:

> Admittedly, my knowledge of formative assessments is limited… the students' perception of them as being used only for bonus points or to enforce attendance, I do not employ them…in-class discussion seems to be beyond the students' comfort level for much of the basic science content, though students are more willing to engage when the topic is more opinion/attitudinal vs. factual (Pre-sort survey, question no. 2).

In the post-sort discussion, this sorter suggested that the decisions to use formative assessments, with or without technology, were largely based on how she felt students would react to them. This sorter's implementation practices were very much driven by student perception and acceptance of the practice.

Prior Experience Defines Use. The hesitancy to use technology, specifically clickers, for this group was based on prior experience with the technology. The factor analysis and interpretation for this factor generated a sense that, for *Cautious Users*, technology hindered student interaction, a concept this group felt was key to student learning. One sorter explained that he stopped using clickers to formatively assess his students because verbal questioning without clickers allows "students to interact to find answers to my questions. I am a content expert with a limited formative assessment knowledge" (Post-sort interview, question no. 2).

The similarities among the sorters in this group indicate a large degree of ambivalence toward the use of technology to implement formative assessments based on observation through practice. However, the factor analysis and interpretation also indicate the possibility that prior negative experiences with technology and formative assessments influence their current implementation practices. The array for *Cautious Users* suggests

a strong agreement with "I enjoy frequent classroom questioning to assess student progress" (statement 28, array position 3), and a solid disagreement with "I often use educational technology to implement formative assessment" (statement 14, array position -2). Commentary from this group in the pre-sort survey and the post-sort interview support this view and imply the cause as negative prior experience. One *Disillusioned and Hesitant User* explained "Given the frequency of glitches with clicker questions—and the students' perception of them as being used only for bonus points or to enforce attendance, I do not employ them" (Pre-sort interview, sorter no. 3).

When asked to describe their feelings toward student overall performance based on the use of formative assessment, the *Cautious Users* group shared agreement that formative assessments help students understand what they do, or do not, know at a given time. However, there was also agreement with "I am not aware of the best practices associated with implementing formative assessments" (statement 27, array position 2). Upon further factor analysis and interpretation, the *Cautious Users* group admittedly allow a disheartening prior experience to affect their view of how formative assessment should be used. Regarding a poor experience, one sorter said:

> I fear that some of our formative assessment strategies—specifically, clicker questions—have been implemented in ways that are inappropriate given the purpose of formative assessments. As a result, the students respond to them negatively, and I fear that many generalize that negative attitude to other attempts at formative assessment, as well. In short, we seem to have created a culture in which our attempts to reinforce learning by use of formative assessments are complicated because a) we use the techniques inappropriately; b) the students

> have very negative responses to what they perceive as extra work—which extends to other attempts to use formative assessments; and c) we respond to student complaints in a way that reinforces the students' negative attitudes toward these assessments (Pre-sort survey, sorter no. 3).

In the discussion that followed this participant's sorting experience, it was explained that this sorter has simply had impressionably bad experiences when she attempted formative assessments with technology in the past and she cannot help but let it drive her perception and practices involving formative assessment (post-sort discussion, sorter no. 3).

This chapter provided an overview of the results of the data analysis process. Specific sections discussed the analysis of the Q sorts, factor interpretation, and factor naming. Finally, an in-depth explanation of the findings for each factor groups was provided.

CHAPTER V

CONCLUSIONS AND DISCUSSION, AND IMPLICATIONS

The purpose of this study was to examine faculty perceptions of formative assessments and their relationship to implementation practices. This chapter will present a summary of the findings and conclusions, provide a discussion of the implications for future practice and research, and present possible limitations of the study.

Summary of Findings

The perceptions of formative assessment, with and without educational technology, at a local medical school were captured through Q methodology. Q sorts, consisting of 36 statements about formative assessment, implementation, and educational technology, were completed by 20 faculty members from the medical school. The sorts were analyzed with PQmethod software (Schmolck, 2014). The result of this analysis was a four-factor solution that was interpreted using additional qualitative data gathered for the study- demographic questionnaires, pre-sort surveys, and post-sort interviews. There were four factors that resulted from the analysis and interpretation of the data that represented both similarities and distinctions in the participants' viewpoint about, and their experiences with formative assessments. The four factors were identified

as *Confident Users, Unfamiliar Supporters, Purposeful User, and Cautious Users*; each with their own distinguishing characteristics.

Faculty in the *Confident Users* group expressed a passion for using formative assessment, with or without technology, and often before others. Interpretation of their Q sorts, survey results, and interview data showed that they share a level of confidence with formative assessment that influences their willingness to implement them. Additionally, the data for this group showed they collectively felt formative assessments are important to the learning process. Faculty in the *Unfamiliar Supporters* group were primarily clinical faculty who felt they were content experts in their field, but had very little knowledge about formative assessments. Their Q sorts, survey results, and interview data presented a view that lack of time to develop an understanding and use of formative assessment was the greatest barrier to their implementation practices. The Q sort, survey results, and interview data for the *Purposeful User* group showed a strong familiarity with formative assessment and some shared perspectives with the *Confident Users* group. However, the data also showed that a level of pride in the content knowledge and purpose was very high for this group. Finally, faculty in the *Cautious Users* group expressed familiarity with formatives assessment, but were not invested in them. Interpretation of their Q sort, survey, and interview data showed that these faculty have unsuccessful past experience from which their decisions about formative assessments are made. They collectively agreed that frequently asking questions is important to the learning process, but they were no longer willing to implement them with educational technology.

Conclusions and Discussion

What are faculty perceptions of formative assessments with or without technology?

A common, meaningful conclusion among the faculty in this study is that formative assessment is considered important and useful to the learning process and successful student outcomes. These faculty agreed that formative assessment needs to occur regularly in the learning process. Black and Wiliam (1998b) indicated that any activity performed by both teachers and students in which feedback was provided are considered formative and have a positive impact on the learning process. Results from this study indicate that, in general, faculty agree. Literature supports the idea that assessment and teaching should be reciprocal and not mutually exclusive, but this concept is not a fully embraced by faculty (Black & Wiliam, 1998a; Heritage, 2007). However, findings from this study showed that faculty at the medical school used in this study collectively feel assessment should occur during instructional time. These faculty reported they enjoy frequent classroom questioning and using different teaching methods that incorporate assessment into the teaching process. These themes are also supported in the literature (Bell & Cowie, 1999; Carol, 2002; Wiliam, 2006; O'brien, 2008; Popham, 2008).

A second conclusion is that about half of the participants in this study did not care to use educational technology to implement formative assessments. The faculty in the *Unfamiliar Supporters* group expressed views about the use of educational technology that indicated unfamiliarity with the technology itself or how it can enhance the implementation of formative assessments. Most participants in this group expressed the belief that educational technology facilitates learning activities, but only a few expressed

belief in its ability to enhance instruction. This finding aligns with literature that suggests although educational technology resources have grown tremendously over the past decade, pedagogical approaches to assessment are not changing as quickly (Brown & Glasner, 1999; Trehan & Reynolds, 2002; Jenkins, 2005; Charma, 1999; Miller 2009).

An interesting finding was the large disconnect faculty indicated in recognizing the relationship between formative assessment and educational technology. Faculty appeared to not fully understand how educational technology can be used to deliver formative assessment effectively and this seems to limit their use of, or interest in, the educational technology beyond the student response systems, or clickers to deliver formative assessments.

An additional interesting finding related to the use of educational technology was the contradictory array for the participants in the *Cautious Users* group. The faculty in this group consistently agreed they rarely or never use clickers during instruction, were ambivalent about use of computer-based assessments and strongly disagreed with using technology to implement formative assessment. They also expressed ambivalence towards knowing how educational technology can enhance implementation of formative assessment. Contrary to this however, they reported that they rely on technology to provide the feedback to students. Their contradiction is reasonable; however, it is very likely rooted in the belief that using educational technology to implement assessment is not without its risks. Technological malfunctions or a lack of development opportunities often influence its use; therefore, understanding the best practices and purpose for its use is critical to a successful implementation (Peat & Franklin, 2002; Nicol & Mcfarlane-Dick, 2004; Caldwell, 2007; Miller 2009).

The finding that about half of the participants in the study do not use educational technology to implement formative assessments, or at all during instruction, illustrates a point that although there is often an institutional expectation for faculty to teach with technology, many faculty perceive technology as intimidating, difficult to learn, difficult to use, or as an intrusion on their pedagogical practices. This finding has implications for practice and professional development. It demonstrates the importance of educational resources and professional development opportunities according to individual needs and interests, a view supported by literature (Peat & Franklin, 2002; Caldwell, 2007; Miller 2009; Pastor, 2011; William, 2011). When formative assessment—with or without technology—is incorporated into the classroom setting, it provides useful information needed to adjust teaching methods for improvement (Garrison & Ehringhaus, 2007). One of the key methods for engaging students in the classroom is through the technique of frequent questioning. Educational technology tools provide faculty with innovative resources to carry out this method of formative assessment. While it is not necessary to always use technology to implement assessments, the majority of the participants in this study strongly agreed that they enjoy using frequent questioning in class to assess student progress. The two faculty in the *Cautious Users* group report this as well but make no connection between frequent questioning and the use of educational technology. This may explain their contrary sorting array and ambivalence toward implementation of formative assessments with technology.

How does faculty perception of formative assessments influence implementation practices?

A third conclusion is faculty perceived that the implementation of formative assessment requires an increase in the amount of time, effort, and work they must commit to their teaching process. Their perception of these commitments, and the additional work associated with them, often influence desire to use formative assessments. Wiliam (2011) reported that effective teaching often stems from the work that occurs before the students arrive. Faculty in the *Confident Users* and *Purposeful User* groups reported evidence of using formative assessments often despite the additional time and resources necessary to implement them. Conversely, faculty in the *Unfamiliar Supporters* group confirmed that knowledge, time and resources are key barriers to implementing formative assessments, which is supported in the literature (Krasne et. al., 2006; Pastor, 2011; Heritage, 2007). There is often a large investment of time and effort involved in the planning and implementation of formative assessment. The literature suggests that faculty perception of this barrier affects their integration of formative assessments into their instructional methods (Krasne et. al., 2006; Pastor, 2011; Heritage, 2007). Resources and tools used for formative assessment can improve implementation practices, but if faculty perceive it to be too time consuming to learn how to use the resources and tools, then improving their implementation practices of formative assessment is not a priority (Wiliam, 2006; Pastor, 2011).

Additionally, this group reported evidence that they are not aware of best practices for implementing formative assessments, and their unfamiliarity and lack of confidence with formative assessment prevents successful implementation, which can

hinder the learning process (Sadler, 1989; Black & Wiliam, 1998; White et. al., 2011). Key data that contributed to this finding included statements that were polar opposite in nature: *Confident Users* consistently stated that increasing the use of formative assessment will provide a better learning experience for students, they are aware of different types of formative assessments, and they feel they have a good understanding of formative assessments; *Unfamiliar Supporters* consistently stated they do not feel confident in their understanding of formative assessment, that they believe formative assessment is likely useful, but they are not familiar enough with them to be sure, and that they are unsure what the term formative assessment means. Despite the contrary perceptions between the groups regarding perception's influence on implementation practices of formative assessment, the results of this study indicate that both groups feel they should be used.

A fourth conclusion is a large number of participants in the study who perceive value in formative assessment and implement them regularly do not understand what to do with the results or how to use the feedback appropriately. Many faculty in the *Confident Users* and *Purposeful User* group reported they want to use assessments to make informed decisions about how to teach (Sadler, 1989). Most of the *Confident Users* expressed the need to know the purpose of the assessment and how feedback would be used before implementation, while the *Purposeful User* group explicitly stated that knowing the purpose and strategy for giving feedback is key (Clark, 2011). However, the *Unfamiliar Supporters* group reported they don't always know the purpose behind implementing formative assessment, don't regularly provide feedback when using

formative assessments because they "don't really know what to do with the results of formative assessments" (statement 34).

An interesting finding was related to the slightly contradictory views of formative assessment in the *Cautious Users* array—they agreed they use the results of formative assessments to give feedback to students, but they don't really know what to do with the results of formative assessments. One sorter from this group explained using formative assessment because there is an expectation to, but feels they have been implemented inappropriately and students have negative experiences with them (sorter 3). This sorter's perceptions and experiences are supported in the literature, which suggests that many faculty have little experience with formative assessments, and therefore experience: ineffective learning, negative impact of the assessment, implementation of managerial versus instructional assessments, poor use of feedback and hindering student success and self-regulation of learning (Black and Wiliam, 1998; Jimma, 2011; McCallum, 2000; Nicol & Mcfarlane-Dick, 2006).

Implications

This Q study revealed interesting, yet preliminary, findings about faculty perceptions of formative assessments and the relationship of perception to their implementation practices in a local medical school. The goal was to acquire information rather than to confirm a hypothesis. Consequently, the findings are preliminary and require future research to confirm the validity of the conclusions across a greater population of faculty. The findings of this study suggest implications for future research, professional development, and pedagogical practice.

Research Implications

To date, there is sufficient research that addresses various topics related to formative assessment, but little research exists on faculty's perception of formative assessment and its influence on implementation practices. This study compliments the existing body of research on formative assessment by addressing an increasingly important pedagogical element—influence of perception on practice. Additionally, the results of this study add the experiences and opinions of the participants to the literature.

Previous research involving formative assessment has primarily addressed K-12 or Higher Education teachers and faculty. The majority of faculty in this study revealed their perception of formative assessment heavily influenced their implementation practices. The results of this study indicate a strong difference between two types of faculty that exist in a medical school: Biomedical Scientists and Clinical Physicians. The majority of clinical faculty in this study showed they did not implement them at all because they "don't know what formative assessment is" (sorter 16), they are "not clear on the term" (sorter 15), or their "knowledge level of formative assessment is low" (sorter 18). However, the value they place on frequently asking questions during class is high, indicating they implement formative assessments, but are not aware of it. This study also shows that not all faculty who perceive formative assessment as valuable implement them; findings indicate these faculty feel unprepared to implement them appropriately.

Previous research surrounding formative assessment and technology primarily discusses the technology, its purpose, and the best practices for its use. This study demonstrates a need for future research to show faculty how educational technology is

used to implement formative assessment, and how and why its implementation improved student outcomes. Half of the participants in this study understood the value of formative assessment, but were not convinced that they were capable of, or interested in, using educational technology to formatively assess students. Therefore, this study identifies a need for future research into the implementation practices of formative assessment with educational technology.

An exciting finding related to pedagogical practice as well as research was participation in this study piqued the interest in formative assessment for the faculty. This study provided awareness of teaching methods and formative assessment to faculty that was not there previously. Clinical faculty participants in particular have shown increased interest in learning more about formative assessment in their pre-clinical medical education teaching roles. Additionally, the number of overall faculty participants utilizing the educational development resources as well as their overall willingness to explore educational technology has increased since their participation in this study. The interest in formative assessment and the initiative to increase awareness and use of formative assessment, which this study stimulated, provides supporting evidence for faculty's desire to improve their pedagogical practices to improve student outcomes. Consequently, this finding reveals the opportunity and importance of conducting design-based research related to faculty practice and formative assessment. Design-based research is "a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, ad implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories" (Wang & Hannafin, 2005, p. 6).

Conducting design-based research with the faculty participants in this study using their real-world teaching environments would provide opportunities to solve issues related to the use of formative assessment in their pre-clinical medical education teaching practices.

The results of this study also confirmed faculty perception related to the importance of using formative assessment for student engagement. Many of the participants in this study indicated that formative assessments provide engagement opportunities for students and feel those opportunities have a positive impact on student learning. Several faculty in this study also highlighted that student perception of these opportunities determined faculty use of formative assessments. Because of this, there is an important research need to explore any relationships between implementation practices and student outcomes through further research.

Service - Professional Development

Many of the faculty in this study perceive formative assessment, with and without technology, as useful but felt they were not equipped to use them. The results of this study suggest the need for implementing or improving professional development opportunities for faculty on using formative assessments. Eleven of the 20 faculty indicated a major factor for not using formative assessments was the lack of time to learn the educational technology. This perception is consistent with literature, which shows that faculty often equate assessment with technology, and avoid the former because of the latter (Peat & Franklin, 2002; Caldwell, 2007; Miller 2009; Pastor, 2011; William, 2011). Subsequently, the results of this study suggest the need for implementing or improving professional development opportunities for faculty on using formative assessments.

This study highlights the strong difference between two types of faculty in a medical school: Biomedical Scientists and Clinical Physicians. Pointing out the differences is not meant to presume one group is better at teaching than the other; rather, it is meant to emphasize that faculty with vastly different roles have different development needs. Only four of the 20 faculty indicated that a lack of professional development opportunities were offered to use the educational technology. This implies that, at the medical school used in this study, development opportunities exist, but still do not meet the individual needs of a particular group of faculty, clinicians.

The results of this study support the need to provide development opportunities at a time, place, and through delivery modes that provide convenience and flexibility for clinical faculty, who often have unpredictable and complicated schedules (Wiliam, 2011). The individuals responsible for the educational development of faculty could implement the following development practices in order to accommodate all faculty:

- Plan and advertise development opportunities far enough in advance to allow faculty to adjust their busy schedules.
- Use web conferencing technology to live-stream development opportunities—faculty can participate from a distance.
- Develop programs such as: Summer Series of Development Opportunities, or a Campus-Wide Technology Fair to accommodate faculty schedules (Brown, 1999).
- Record all development sessions and make them available to faculty to review at their convenience.
- Create a Faculty Development platform where faculty can access all development session and materials 24/7.
- Create self-paced tutorials for faculty to work through at their convenience after a development session—permanently housed in the development platform.

- Allow faculty to make appointments to meet with educational development team members for one-on-one training or for follow up guidance (Brown, 1999).

The goal of professional development would be to allow faculty to access development materials and sessions at any time and from anywhere and to encourage faculty to seek out educational development personnel for additional assistance and guidance.

Most of the participants in this study reported that using educational technology enhances instruction and helps facilitate learning activities. Based on the results of this study, the educational development personnel at the medical school in this study have begun designing and developing a teaching certificate course for faculty teaching in pre-clinical medical education titled *Academic Medicine*. In order to address the following concepts, issues, and practices related to teaching with and without educational technology, the course will introduce and demonstrate the following:

- Relevant educational theories
- Relevant instructional methods
- Development of appropriate learning materials
- Practices associated with the creation and implementation of assessments (formative and summative)
- Practices associated with assessment feedback
- Establishment of a positive and professional learning environment
- Process of conducting educational research

This course will allow faculty opportunities for real-world practice to increase awareness, experience, and comfort levels with using educational technology in their teaching and to implement formative assessments.

Teaching - Pedagogical Practice

This study revealed that faculty who perceived themselves as knowledgeable about formative assessment were more likely to implement this type of assessment than those who perceived themselves as unknowledgeable or unaware. Prior to their participation in the study, many of the clinical faculty expressed their lack of understanding of formative assessment. Consequently, the same faculty expressed a strong desire to discuss formative assessment after their study experience was complete. It was apparent during those discussions that although they may have a discomfort with formative assessments, they have a strong desire to learn how to use them, with and without educational technology, and how they can improve student outcomes.

Therefore, this study could also provide research-based support for teaching faculty why formative assessments are important and how to effectively implement them using educational technology. Once faculty understand why and how formative assessments are used, they can begin to adjust their pedagogical practices by incorporating them into their teaching. Faculty could move beyond using clickers in a large group setting to using them facilitate small group, case-based teaching in the classroom to pre-assess knowledge and assess students with a formative technique during the learning session. Additionally, faculty could embed formative assessments into recorded ‘pre-lectures’ or captured lectures to allow students different opportunities to

engage in the content (Davis et. al., 2009). Lastly, faculty could create self-paced tutorials for students using educational technology platforms, such as Nearpod, to allow students additional means for content engagement in a low-stakes, formative manner (Loucky, 2016).

Faculty could use the results of the formative assessments to make instructional decisions before, during, or after the learning session that would provide students with a more purposeful and meaningful learning experience (The Assessment Reform Group (ARG), 1999; McCallum, 2000). Students would benefit from not only the additional opportunities to engage the content, but they would also benefit from the self-regulation of their learning these methods would provide (Black & Wiliam, 1998; Nicol & Mcfarlane-Dick, 2006).

Limitations

This study was limited by my *a priori* knowledge of the participants' teaching practices because of my close working relationship of the participating faculty. While this knowledge was an asset in that it helped me anticipate important challenges and opportunities to explore, it also may have narrowed my perspective during the development of the Q set and the survey questionnaire, my interpretation of factors and results, and perhaps even the direction of participants' responses. Any future replication of this study should explore the idea of using participants with which there is no prior established working relationship.

A second limitation was my *a priori* assumptions about formative assessment, the use of educational technology in teaching, and pedagogical philosophies. As an

instructional designer, I have established research-based understandings of formative assessment and pedagogy. These assumptions likely influenced the development of the Q set as well as the factor and results interpretation. My use of statements that were a) too strongly worded toward the extreme (always versus never) and b) based on personal experience with teaching and developing faculty possibly limited the information I could have acquired from the participants. Any future replication of this study should consider revising or replacing statements 10, 16, 22, and 23.

Another limitation was my selection of participants; although I used purposeful selection, the faculty I selected from the willing set of participants represented an almost equal ratio of biomedical to clinical faculty. My desire to have equal representation of biomedical and clinical faculty possibly influenced the overall direction of the study's data. It is unknown if randomly selecting from the group of willing participants would have resulted in a less equal distribution therefore providing different survey and interview data and factor analysis for interpretation, but any future replication of this study may benefit from a random selection of faculty. Because I used purposive sampling, the results of this study may not be generalizable to all faculty who teach in a medical school environment. As mentioned previously, Q methodology is used to identify attitudes or perceptions of the participants, and the goal was to explore the perceptions of only the faculty in this study.

Summary

In summary, faculty perception of formative assessment has an influence on their implementation practices and possibly student outcomes. Faculty who feel

knowledgeable and comfortable with formative assessment are potentially more willing to invest the time and effort to implement them. Although many of the faculty in this study felt they understood what formative assessments are and support the use of them, those perceptions did not necessarily equate to knowing how to effectively use the results and give feedback to students.

Additionally, despite institutional expectations to use educational technology in teaching, faculty may not implement formative assessments at all, with or without technology. Faculty make decisions to use technology in teaching based on their comfort level, time to learn to use it appropriately, and prior, successful or unsuccessful, experiences using educational technology to deliver formative assessments.

REFERENCES

Al-Wassia, R., Hamed, O., Al-Wassia, H., Alafari R., & Jamjoom, R. (2015). Cultural challenges to implementation in Saudi Arabia: An exploratory study. *Medical Teacher*, 37, S9-S19.

Anderson, C. (2010). Presenting and evaluating qualitative research. *American journal of pharmaceutical education*, 74(8), 1-7.

Barry, J., & Proops, J. (1999). Seeking sustainability discourses with Q methodology *Ecological economics*, 28(3), 337-345.

Bell, B., & Cowie, B. (2001). The characteristics of formative assessment in science education. *Science education*, 85(5), 536-553.

Bennett, R. (2011). Formative assessment: A critical review. *Assessment in education: Principles, Policy, & practice*, 18(1), 5-25.

Black, P. & Wiliam, D. (1998a). Assessment and classroom learning. *Assessment in Education*, 5(1), 7-74.

Black, P. & Wiliam, D. (1998b). Inside the black box: Raising standards through classroom assessment. *Phi Delta Kappan*, October, 139-148.

Black, P. & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational assessment, evaluation, and accountability*, 21, 5-31.

Black, P., Harrison, C., & Lee, C. (2003). *Assessment for learning: Putting it into practice*. McGraw-Hill Education (UK).

Black, P., Harrison, C., Hodgen, J., Marshall, B., & Wiliam, D. (2005). The dissemination of formative assessment: a lesson from, or about, evaluation. *Research Intelligence*, 92, 14-15.

Bloom, B. S. (1956). *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook 1; Cognitive Domain*. New York: David McKay Co. Inc.: pp. 7-8.

Bloom, B. S. (1969). Some theoretical issues relating to educational evaluation. *Educational evaluation: new roles, new means: the 63rd yearbook of the National Society for the Study of Education*, (part II), 26-50.

Brown, S. R. (1993). A primer on Q methodology. *Operant subjectivity*, 16(3/4), 91–138.

Brown, S. R. (1996). Q methodology and qualitative research. *Qualitative health research*, *6*(4), 561-567.

Brown, D.G. (1999). Faculty Development Strategies. In B. Collis & R. Oliver (Eds.), *Proceedings of EdMedia: World Conference on Educational Media and Technology 1999* (pp. 1229-1230). Association for the Advancement of Computing in Education (AACE).

Brown, G. T. (2004). Teachers' conceptions of assessment: Implications for policy and professional development. *Assessment in Education: Principles, Policy & Practice*, *11*(3), 301-318.

Brown, S. (2004). Assessment for learning. *Learning and teaching in higher education*, *1*(1), 81-89.

Caldwell, J. E. (2007). Clickers in the large classroom: Current research and best-practice tips. *CBE-Life Sciences Education*, *6*(1), 9-20.

Carol, B. (2002). The Concept of Formative Assessment. College Park MD: ERIC Clearinghouse on Assessment and Evaluation.

Cauley, M. & Mcmillan, J. (2010). Formative assessment techniques to support student motivation and achievement. *The clearinghouse: A journal of educational strategies*, 83(1), 1-6.

Chan, C. K. Y., Tam, V. W., & Li, C. Y. V. (2011). A comparison of MCQ assessment delivery methods for student engagement and interaction used as an in-class formative assessment. *International Journal of Electrical Engineering Education*, *48*(3), 323-337.

Chappuis, S., & Chappuis, J. (2007). The best value in formative assessment. *Informative assessment*, 65(4), 14-19.

Charman, D. (1999) *Issues and impacts of using computer-based assessments (CBAs) for formative assessment*, in S. Brown, P. Race & J. Bull (eds) Computer-assisted Assessment of Students, London: Kogan Page.

Clark, I. (2011). Formative Assessment: Policy, Perspectives and Practice. *Florida journal of educational Administration & Policy*, *4*(2), 158-180.

Collins, L. J. (2009). *Participants' Perceptions of the Instructional Design of an Online Professional Development Module for Teaching English Language Learners: A Q Methodology Study*. ProQuest LLC. Retrieved from eric.

Colliver, J. (2002). Constructivism: The view of knowledge that ended philosophy or a theory of learning and instruction? *Teaching and Learning in Medicine*,

14(1), 49-51.

Colliver, J. (2002b). Educational theory and medical education practice: A cautionary note for medical school faculty. *Academic Medicine*, 77(12), 1217-1220.

Connolly, L. (2013). Demographic data in research studies. *MEDSURG Nursing*, 22(4), 269-270.

Coogan, J. & Herrington, N. (2011). Q methodology: An overview. *Research in Secondary Teacher Education*, 1(2), 24-28.

Corr, S. (2001). An introduction to Q methodology, a research technique. *The British Journal of Occupational Therapy*, *64*(6), 293-297.

Cross, R.M. (2005). Exploring attitudes: the case for Q methodology. *Health education research*, 20(2), 206-213.

Crotty M. (2003). *The foundations pf social research*. Los Angeles: Sage.

Danielson, S. (2009). Q method and surveys: Three ways to combine Q and R. *Social and Environmental Research Institute*, 21(3), 219-237.

De Vos, M. & Belluigi, D. Z. (2011). Formative assessment as mediation. *Perspectives in education*, 29(2), 39-47.

Dennis, K. E. (1986). Q methodology: relevance and application to nursing research. *Advances in Nursing Science*, *8*(3), 6-17.

Donner, J. C. (2001). Using Q-sorts in participatory processes: An introduction to the methodology. *Social Development Papers, 36*, 24-49. Retrieved from: http://siteresources.worldbank.org/SOCIALANALYSIS/1104890-1120158652972/20566697/SDP-36.pdf-page=30

Doolittle, P. & Hicks, D. (2003). Constructivism as a theoretical foundation for the

use of technology in social studies. *Theory & Research in Social Education*, 31(1), 72-104.

Drew, S. & Klopper, C. (2014). Evaluating faculty pedagogic practices to inform strategic professional development: A case of cases. *Higher Education*, 67, 349-367.

Duenckmann, F. (2010). The village in the mind: Applying Q-methodology to re-constructing constructions of reality. *Journal of rural studies*, 26, 284-295.

Dunn, K. E., & Mulvenon, S. W. (2009a). A critical review of research on formative assessment: The limited scientific evidence of the impact of formative assessment in education. *Practical Assessment, Research & Evaluation, 14*(7), 1-11.

Dunn, K. E., & Mulvenon, S. W. (2009b). Let's Talk Formative Assessment...and Evaluation? *Online Submission*. Retrieved from https://eric.ed.gov/?id=ED505357

Eden, S., Donaldson, A., & Walker, G. (2005). Structuring subjectivities? Using Q methodology in human geography. *Area*, 37(4), 413-422.

Evans et al. (2014). Motivating student learning using a formative assessment journey. *Journal of Anatomy*, 224, 296-303

Fosnot, C. (1996). Constructivism: A Psychological theory of learning. In C. Fosnot (Ed.), *Constructivism: Theory, perspectives and practice*, (pp.8-33). New York: Teachers College Press.

Gallagher, K. & Porock, D. (2010). The use of interviews in Q methodology. *Nursing Research*, 59(4), 295-300.

Garrison, C., & Ehringhaus, M. (2007). Formative and summative assessments in the classroom. *Measured Progress.* Retrieved from http://schools.nyc.gov/NR/rdonlyres/33148188-6FB5-4593-A8DF-8EAB8CA002AA/0/2010_11_Formative_Summative_Assessment.pdf

Gibbs, G., Simpson, C., Gravestock, P., & Hills, M. (2005). Conditions under which assessment supports students' learning. *Learning and teaching in higher education*. 1, 3-31.

Gikandi, J. W., Morrow, D., & Davis, N.E. (2011). Online formative assessment in higher education: A review of the literature. *Computers & education*, 57, 2333-2351.

Hammer, C. S. (2011). The importance of participant demographics. *American Journal of Language Pathology*, 20, 261.

Hargreaves, E. (2005). Assessment for learning? Thinking outside the (black) box. *Cambridge Journal of Education*, *35*(2), 213-224.

Harlen, W., & James, M. (1997). Assessment and learning: differences and relationships between formative and summative assessment. *Assessment in Education*, *4*(3), 365-379.

Hattie, J. (1999). Influences on student learning. University of Auckland, New Zealand: Inaugural professorial lecture. Retrieved from www.citeseerx.ist.psu.edu/viewdoc/downloaddoi=10.1.1.114.8465.pdf

Hattie, J., & Temperley, H. (2007). The power of feedback. *Review of Educational Research*, 77(1), 81-112.

Heritage, M. (2007). Formative assessment: What do teachers need to know and do? *Phi Delta Kappan*, *89*(2), 140.

Hernández, R. (2012). Does continuous assessment in higher education support student learning? *Higher Education*, *64*(4), 489-502.

Hollingsworth, A. B. (2013). *Q methodology as a needs assessment tool for biology graduate teaching assistants participating in an instructional training program* (Order No. 3671126). Available from ProQuest Dissertations & Theses Global. (1645957492). Retrieved from http://search.proquest.com/docview/1645957492?accountid=3320

Hudson, J. N., & Bristow, D. R. (2006). Formative assessment can be fun as well as educational. *Advances in Physiology Education*, *30*(1), 33-37.

Hutson, G. & Montgomery, D. (2011). Demonstrating the value of extending qualitative research strategies into Q. *Operant Subjectivity: The International Journal of Q Methodology, 34(4), 234-246.*

James, D., & Fleming, S. (2004). Agreement in student performance in assessment. *Learning and Teaching in Higher Education*, *1*(05), 32-50.

Jenkins, M. (2004). Unfulfilled promise: formative assessment using computer-aided assessment. *Learning and Teaching in Higher Education*,*1*(1), 67-80.

Jimaa, S. (2011). The impact of assessment on students learning. *SciVerse Science Direct*, 28, 718-721.

Juwah, C., Macfarlane-Dick, D., Matthew, B., Nicol, D., Ross, D., & Smith, B. (2004). Enhancing student learning through effective formative feedback. *The Higher Education Academy Generic Centre.* Retrieved from http://ctlt.illinoisstate.edu/downloads/modules/design/enhancing_learning-through_formative_feedback.pdf

Kadri, H., Al-Moamary, M.S., & van der Vleuten, C. (2009). Students' and teachers'

perceptions of clinical assessment program: A qualitative study in a PBL curriculum. *BMC Research Notes,* 2(263), 1-7.

Kerr, K. A., Marsh, J. A., Ikemoto, G. S., Darilek, H., & Barney, H. (2006). Strategies to promote data use for instructional improvement: Actions, outcomes, and lessons from three urban districts. *American Journal of Education*, *112*(4), 496-520.

Koh, L.C. (2010). Academic staff perspectives of formative assessment in nurse education. *Nurse education in practice*, 10, 205-209.

Krasne, S., Wimmers, P. F., Relan, A., & Drake, T. A. (2006). Differential effects of two types of formative assessment in predicting performance of first-year medical students. *Advances in Health Sciences Education*, *11*(2), 155-171.

Linden, D. (1985). Medical students. Views regarding the role of empathy in patient-physician interactions. Retrieved from: http://gradworks.umi.com/32/59/3259587.html

Loucky, J. P. (2016). Studies of Flipping Classes with Asian Students. *Flipped Instruction Methods and Digital Technologies in the Language Learning Classroom*, 64.

Lutze-Mann, L., & Kumar, R. K. (2013). The formative assessment lecture: enhancing student engagement. *Medical education*, *47*(5), 526-527.

Maxwell, J. (1992). Understanding and validity in qualitative research. *Harvard educational review*, 62(3), 279-300.

Mauch, L. (2007). Motivating students through formative feedback. *Strategies*, *20*(4), 23-27.

McCallum, B. (2000). Formative assessment: Implications for classroom practice.

Institute of education. Retrieved from http://dera.ioe.ac.uk/4565/1/formative(1).pdf

McKeown, B. & Thomas, D. (2013). *Q methodology*. Los Angeles: Sage.

Miller, T. (2009). Formative computer-based assessment in higher education: the effectiveness of feedback in supporting student learning. *Assessment & Evaluation in Higher Education*, *34*(2), 181-192.

Nicol, D. J., & Macfarlane-Dick, D. (2004). Rethinking formative assessment in HE: a theoretical model and seven principles of good feedback practice. *Higher Education Academy*. Retrieved from http://www.enhancementthemes.ac.uk/pages/docdetail/docs/workshop/rethinking-formative-assessment-a-theoretical-model-and-seven-principles-of-good-feedback-practice-paper

Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in higher education*, *31*(2), 199-218.

O'brien, M. (2008). Formative assessment. *Connect.* Retrieved from http://synergylearning.org/

Pastor, V. (2011). Best practices in academic assessment in higher education: A case in formative and shared assessment. *Journal of technology and science education*, 1(2), 25-39.

Peat, M. & Franklin, S. (2002) Supporting student learning: the use of computer-based formative assessment modules, *British Journal of Educational Technology*, 33(5), 515-523.

Perera, J., Lee, N., Win, K., Perera, J., & Wijesuriya, L. (2008). Formative feedback to

students: the mismatch between faculty perceptions and student expectations. *Medical Teacher*, 30, 395-399.

Perie, M., Marion, S., Gong, B., & Wurtzel, J. (2007). The role of interim assessments in a comprehensive assessment system. *Washington, DC: The Aspen Institute. Retrieved December*, *3*, 2009.

Popham, W.J. 2008. Transformative assessment. Alexandria, VA: ASCD.

Ramlo, S. & Newman, I. (2011). Q methodology and its position in the mixed-methods continuum. *Operant Subjectivity: The Internatinal Journal of Q Methodology*, 34(3), 172-191.

Reid, D. (1999). Investigating teachers' perceptions of the role of theory in initial teacher training through Q methodology. *Mentoring & Tutoring*, *7*(3), 241-255.

Roff et al. (1997). Development and validation of the Dundee Ready Education Environment Measure (DREEM). *Medical Teacher,*19(4), 295-299.

Rolfe, I. & McPherson, J. (1995). Formative assessment: how am I doing? *The Lancet*, 345, 837-839.

Sadler, D. (1989). Formative assessment and the design of instructional systems. *Instructional Science*, 18, 119-144.

Schmolck, P., & Atkinson, J. (2001). PQMethod (version 2.11) [computer program].

Scriven, M. (1967) The methodology of evaluation. In R. Tyler, R. Gagne and M. Scriven (1967) *Perspectives on Curriculum Evaluation* (AERA Monograph Series – Curriculum Evaluation) (Chicago, Rand McNally and Co).

Shemmings, D. (2006). 'Qualifying' qualitative data: An illustrative example of the use

of Q methodology in psychosocial research. *Qualitative research on Psychology*, 3, 147-165.

Stainton Rogers, R. (2995) Q methodology. *Rethinking methods in psychology*. 178-192. Sage: London.

Stefani, L. (2004). Assessment of student learning: promoting a scholarly approach. *Learning and Teaching in Higher Education*, *1*(1), 51-66.

Stenner, P., Cooper, D., & Skevingtonn, S. M. (2003). Putting the Q into quality of life: the identification of subjective constructions of health-related quality of life using q methodology. *Social Science & Medicine*, 57, 2161-2172.

Stenner, P. (2009). Q methodology as a constructivist methodology. *Operant subjectivity: the international journal of Q methodology*, 32(1-3), 46-69.

Stiggins, R. J. (2002). Assessment crisis: The absence of assessment for learning. *Phi Delta Kappan*, *83*(10), 758-765.

The Center for Digital Education. (2014). *Rethinking assessment to improve student outcomes.* Retrieved from http://images.erepublic.com/documents/CDE14+CONSP_Q1_Interactive.pdf

Trehan, K. & Reynolds, M. (2002) Online collaborative assessment: power relations and 'critical learning', in C. Steeples & C. Jones (eds) *Networked Learning: perspectives and issues*, London: Springer-Verlag.

Vaughan, B., Carter, A., Macfarlane, C., & Morrison, T. (2014). The DREEM, part 1: measurement of the educational environment in an osteopathy teaching program. *BMC medical education*, *14*(1), 1.

Vaughan, B., Mulcahy, J., & McLaughlin, P. (2014). The DREEM, part 2: psychometric

properties in an osteopathic student population. *BMC medical education, 14*(1), 1.

von Glasersfeld, E. (1987). Learning as a constructive activity. In C. Janvier, *Problems of representation in the teaching and learning of mathematics*, (pp.3-17). New Jersey: Lawrence Erlbaum Associates, Inc.

von Glasersfeld, E. (1995). A constructivist approach to teaching. In L. Steffe & J. Gale (Eds.). (1995). *Constructivism in education*, (pp.3-16). New Jersey: Lawrence Erlbaum Associates, Inc.

von Glasersfeld, E. (1996). Introduction: Aspects of constructivism. In C. Fosnot (Ed.), *Constructivism: Theory, perspectives and practice*, (pp.3-7). New York: Teachers College Press.

Vygotsky, L. (1978). *Mind in Society: The Development of higher psychological processes.* MA: Harvard University Press.

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development, 53*(4), 5-23.

Watts, S. & Stenner, P. (2005). Doing Q methodology: Theory method and interpretation. *Qualitative Research in Psychology*, 2, 67-91.

Watts, S. & Stenner, P. (2012). *Doing Q methodological research: Theory, method, and interpretation*. Los Angeles: Sage.

White, P., Syncox, D., & Alters, B. (2011). Clicking for grades? Really? Investigating the use of clickers for awarding grade-points in post-secondary education. *Interactive Learning Environments, 19*(5), 551-561.

Wiliam, D., & Black, P. (1996). Meanings and consequences: a basis for distinguishing formative and summative functions of assessment? *British Educational Research Journal*, *22*(5), 537-548.

Wiliam, D. (2006). Formative assessment: Getting the focus right. *Educational Assessment*, *11*(3-4), 283-289.

Wiliam, D. (2011). *Embedded formative assessment.* Bloomington: Solution Tree Press.

Wininger, S. R. (2005). Using your tests to teach: Formative summative assessment *Teaching of Psychology*, *32*(3), 164-166.

Wong, W., Eiser, A. R., Mrtek, R. G., Heckerling, P. S. (2004). By-person factor analysis in clinical ethical decision making: Q methodology in end-of-life care decisions. *The American Journal of Bioethics*, 4, W8-W22.

Wright, P. N. (2013). Is Q for you?: Using Q methodology within geographical and pedagogical research. *Journal of Geography in Higher Education*, *37*(2), 152-163.

Yang, Y. & Montgomery, D. (2013). Gaps or bridges in multicultural teacher education: A Q study of attitudes toward student diversity. *Teaching and Teacher Education*, 30, 27-37.

Yorke, M. (2001). Formative assessment and its relevance to retention. *Higher Education Research and Development*, *20*(2), 115-126.

Yorke, M. (2003). Formative assessment in higher education: Moves towards theory and the enhancement of pedagogic practice. *Higher Education* 45(4), 477-501.

Yorke, M. (2005). Formative assessment in higher education: its significance for

employability, and steps towards its enhancement. *Tertiary education and management*, 11, 219-238.

Yu, H., & Li, H. (2014). Group-based formative assessment: a successful way to make summative assessment effective. *Theory and Practice in Language Studies*, *4*(4), 839.

Zakrezewski, S. and Bull, J. (1999). The mass implementation and evaluation of computer-based assessments. *Assessment and Evaluation in Higher Education*. 23(2), 141-152.

APPENDICES

APPENDIX A

IRB APPROVAL

Oklahoma State University Institutional Review Board

Date:	Thursday, May 26, 2016
IRB Application No	ED16102
Proposal Title:	Faculty perceptions of formative assessment: examination of implementation practices and student outcomes
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 5/25/2019

Principal Investigator(s):

Brandy Close
125 Courtney Circle
Waxahachie, TX 75165

Penny Thompson
210 Willard Hall
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Scott Hall (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Hugh Crethar, Chair
Institutional Review Board

APPENDIX B

Q SET STATEMENTS

Overall Feelings About Formative Assessments

1. I am a content expert with a good understanding of formative assessments. (Black & Wiliam, 1998)
2. I am a content expert with a very limited understanding of formative assessments. (Black & Wiliam, 1998)
3. I understand the difference between formative and summative assessments. (Black & Wiliam, 1998)
4. I do not know the difference between formative and summative assessments. (Black & Wiliam, 1998)
5. I am aware that there are different types of formative assessments that I can use. (Black & Wiliam, 1998)
6. I am not aware that there are different types of formative assessments. (Black & Wiliam, 1998)
7. Formative assessments encourage superficial learning, or rote memory, of content. (Black & Wiliam, 1998)
8. Formative assessments foster a deeper learning of content.
9. Formative assessments should contribute to student's final course grade.
10. Formative assessments should be for practice only and not count towards student grades.
11. I am confident in my ability to formatively assess students.
12. Formative assessments don't really belong in medical education.
13. Formative assessments are useful in any instructional environment.

Formative Assessments and Technology

14. I often use educational technology to implement formative assessments.
15. I am not aware of how educational technology can enhance implementation of formative assessments.
16. I always use clickers to formatively assess students during class.
17. I rarely or never use clickers during instruction.
18. I use computer-based software during instruction to implement formative assessments.
19. I don't use computer-based software assessments during instruction because it takes away from my teaching time.
20. I am aware of the best practices for using clickers in class. (Caldwell, 2007)
21. I did not know that there were any recommended best practices for clicker use. (Caldwell, 2007)

Feedback with Formative Assessments

22. I always know the purpose behind implementing formative assessments in my class.

23. I never plan in class assessments; I do them on the fly when needed.
24. I enjoy implementing new teaching methods before others have. (Caldwell, 2007)
25. I let others implement new teaching methods before I try them. (Caldwell, 2007)
26. I am aware of the best practices associated with implementing formative assessments.
27. I am not aware of the best practices associated with implementing formative assessments.
28. I enjoy using frequent classroom questioning to assess student progress.
29. Formative assessments are a good use of instructional time.
30. I don't know enough about formative assessments to know if I am using them correctly or not.
31. I regularly provide feedback to students when I use formative assessments during instruction.

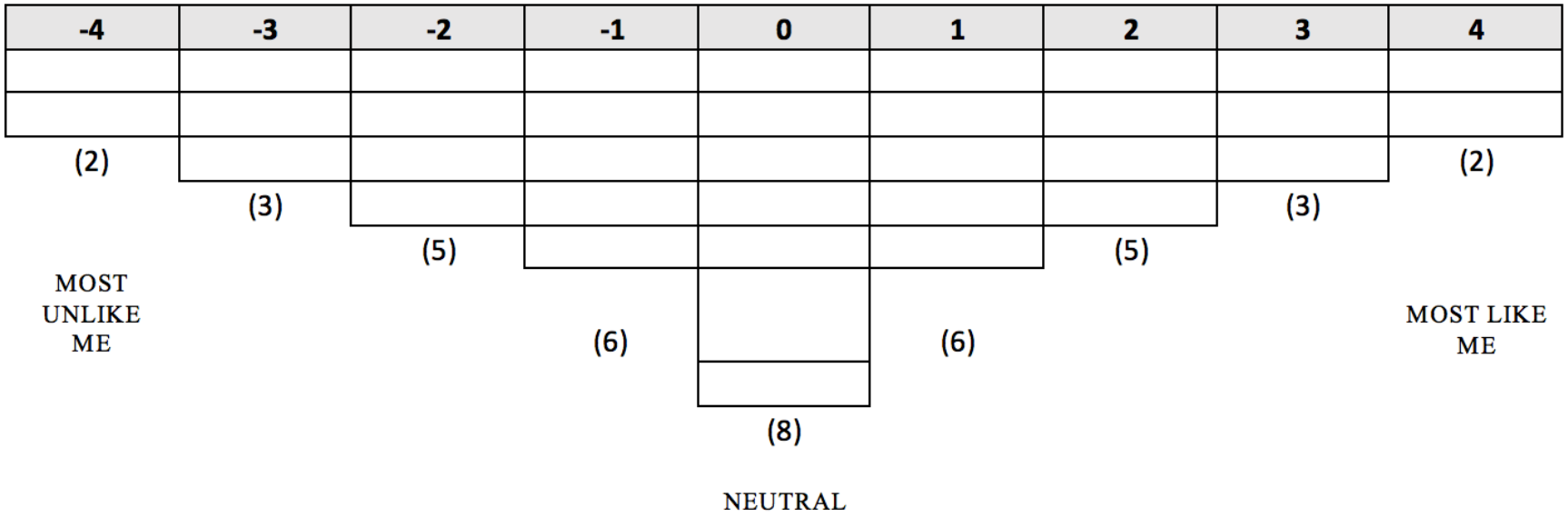
Use of formative Assessments

32. I rely on the technology to provide the feedback to students to save time during instruction.
33. I don't feel that formative assessments provide useful information.
34. I don't really know what to do with the results of formative assessments.
35. I use the results of formative assessments to give feedback to students.
36. I think formative assessments should only be used outside of class so I can maximize my teaching time.

APPENDIX C

Q SORT RECORD SHEET

FACULTY PERCEPTION OF FORMATIVE ASSESSMENT



APPENDIX D

DEMOGRAPHICS QUESTIONNAIRE AND

PRE-SORT SURVEY

Demographics Questionnaire

1. How many years have you been a faculty member?
   ___5 years or less
   ___6-10 years
   ___11-20 years
   ___21 years or more

2. How many years have you been a faculty member at OSU-CHS?
   ___5 years or less
   ___6-10 years
   ___11-20 years
   ___21 years or more

3. At how many different institutions have you been a faculty member? _____

4. What is your current faculty rank?
   ___Professor
   ___Associate Professor
   ___Assistant Professor
   ___Other: _____

5. What is your current faculty designation?
   ___Biomedical
   ___Clinical
   ___Behavioral Health

6. Do you have any K-12 teaching experience?
   ___Yes- For approximately how many years: _____
   ___No

7. What is the highest degree you have earned?
   ___Ph.D.
   ___Ed.D.
   ___D.O.
   ___Phar.D
   ___M.D.
   ___M.Ed
   ___M.S.
   ___M.A.
   ___Other:_____

8. From what institution did you receive your highest degree?
   _____

9. What is your gender?
___Male
___Female

10. What is your age? _____

_____ I prefer not to answer

Pre-Sort Survey

11. Which of the following best matches your racial or ethnic identity? (select all that apply)
___African-American
___Asian
___Hispanic
___Native American or Native Alaskan
___Native Hawaiian or Pacific Islander
___White/Caucasian
___Other
___Prefer not to answer

12. Is English your first (primary) language?
___yes
___No

13. For each of the following technologies, please indicate whether you use them for instructional purposes:
___presentation software (ppt, prezi, etc.)
___Lecture Capture
___Narrated PowerPoints or other Screencasting
___Web conferencing tools (WebEx, Skype, etc.)
___Podcasting
___Streaming audio and/or video (Youtube, etc.)
___eBooks
___Clicker Systems
___Social networking tools (Facebook, twitter, etc.)

14. Please select up to 3 factors that motivate you to use technology in your teaching practices:
___to increase student's access to course materials
___enhancement of instruction
___availability of classroom technology

___encouragement from students
___institutional expectations
___to facilitate learning activities
___convenience and productivity
___support from IT and educational development
___inspiration from peers
___other (please specify): _____

15. Please select up to 3 factors which you consider barriers to your use technology in your teaching practices:
___lack of time to learn the use and integration of the technology
___lack of appropriate technology in the classrooms
___lack of development opportunities to learn how to use and integrate the technology
___lack of appropriate technology in my office
___I do not perceive any barriers
___Other (please specify): _____

16. Describe your feelings/attitude towards using formative assessments in your instructional process?

17. Describe how your perceived knowledge level of formative assessment influences your implementation of them.

18. Describe your feelings towards student overall performance based on the use of formative assessment.

APPENDIX E

STATEMENTS WITH SCORES AND

ARRAY RANKS BY FACTOR

		Confident Users		Unfamiliar Supporters		Purposeful User		Cautious Users	
No.	**Statement**	**Rank**	***z* score**	**Rank**	***z* score**	**Rank**	***z* score**	**Rank**	***z* score**
1	I am a content expert with a good understanding of formative assessments.	15	0.33	34	-1.51	2	1.83	19	-0.09
2	I am a content expert with a very limited understanding of formative assessments	22	-0.23	5	1.41	26	-0.46	1	1.92
3	I understand the difference between formative and summative assessments.	12	0.72	35	-1.68	2	1.83	16	0.3
4	I do not know the difference between formative and summative assessments.	30	-1.04	2	1.6	36	-1.83	13	0.48
5	I am aware that there are different types of formative assessments that I can use.	8	0.94	26	-0.55	21	0	18	0.09
6	I am not aware that there are different types of formative assessments.	27	-0.64	4	1.51	31	-0.91	10	0.69
7	Formative assessments encourage superficial learning, or rote memory, of content.	29	-0.99	17	-0.15	26	-0.46	31	-1.05

8	Formative assessments foster a deeper learning of content.	5	1.12	14	0.25	21	0	4	1.44
9	Formative assessments should contribute to student's final course grade.	16	0.28	12	0.49	36	-1.83	27	-0.6
10	Formative assessments should be for practice only and not count towards student grades.	26	-0.6	22	-0.31	15	0.46	22	-0.27
11	I am confident in my ability to formatively assess students.	14	0.4	29	-0.85	10	0.91	26	-0.57
12	Formative assessments don't really belong in medical education.	36	-1.92	31	-0.9	31	-0.91	35	-1.65
13	Formative assessments are useful in any instructional environment.	10	0.88	11	0.53	21	0	25	-0.39
14	I often use educational technology to implement formative assessments.	4	1.25	28	-0.65	5	1.37	29	-0.96
15	I am not aware of how educational technology can enhance implementation of formative assessments.	28	-0.81	8	1.09	31	-0.91	21	-0.21
16	I always use clickers to formatively assess students during class.	11	0.85	20	-0.26	15	0.46	34	-1.53

17	I rarely or never use clickers during instruction.	34	-1.6	19	-0.22	26	-0.46	2	1.74
18	I use computer-based software during instruction to implement formative assessments.	3	1.25	18	-0.2	10	0.91	20	-0.18
19	I don't use computer-based software assessments during instruction because it takes away from my teaching time.	31	-1.14	15	0.03	31	-0.91	18	0.09
20	I am aware of the best practices for using clickers in class.	13	0.64	32	-0.98	21	0	13	0.48
21	I did not know that there were any recommended best practices for clicker use.	23	-0.37	6	1.33	21	0	25	-0.39
22	I always know the purpose behind implementing formative assessments in my class.	9	0.91	33	-1.42	5	1.37	25	-0.39
23	I never plan in class assessments; I do them on the fly when needed.	33	-1.52	30	-0.9	31	-0.91	36	-1.92
24	I enjoy implementing new teaching methods before others have.	17	0.03	10	0.64	10	0.91	31	-1.05

25	I let others implement new teaching methods before I try them.	18	0	24	-0.5	34	-1.37	15	0.36
26	I am aware of the best practices associated with implementing formative assessments.	21	-0.11	36	-1.87	21	0	28	-0.87
27	I am not aware of the best practices associated with implementing formative assessments.	24	-0.49	3	1.55	15	0.46	6	1.05
28	I enjoy using frequent classroom questioning to assess student progress.	1	1.72	7	1.22	10	0.91	4	1.44
29	Formative assessments are a good use of instructional time.	2	1.66	13	0.41	15	0.46	5	1.17
30	I don’t know enough about formative assessments to know if I am using them correctly or not.	20	-0.09	1	1.79	26	-0.46	14	0.39
31	I regularly provide feedback to students when I use formative assessments during instruction.	7	0.99	27	-0.57	5	1.37	9	0.78
32	I rely on the technology to provide the feedback to students to save time during instruction.	19	-0.02	21	-0.27	34	-1.37	13	0.48

33	I don’t feel that formative assessments provide useful information.	35	-1.64	25	-0.54	15	0.46	33	-1.35
34	I don’t really know what to do with the results of formative assessments.	25	-0.54	9	0.94	26	-0.46	8	0.96
35	I use the results of formative assessments to give feedback to students.	6	1.05	23	-0.39	10	0.91	8	0.96
36	I think formative assessments should only be used outside of class so I can maximize my teaching time.	32	-1.25	16	-0.07	34	-1.37	33	-1.35

APPENDIX F

CRIB SHEETS FOR ALL 4 FACTORS

Factor 1								
-4	-3	-2	-1	0	1	2	3	4
Most Unlike								Most Like
I don't feel that formative assessments provide useful information.	I think formative assessments should only be used outside of class so I can maximize my teaching time.	I am not aware that there are different types of formative assessments	I am a content expert with a very limited understanding of formative assessments.	Formative assessments should contribute to student's final course grade.	I always use clickers to formatively assess students during class.	I use the results of formative assessments to give feedback to students.	I use computer-based software during instruction to implement formative assessments.	I enjoy using frequent classroom questioning to assess student progress
Formative assessments don't really belong in medical education.	I never plan in class assessments; I do them on the fly when needed.	I am not aware of how educational technology can enhance implementation of formative assessments.	I did not know that there were any recommended best practices for clicker use.	I enjoy implementing new teaching methods before others have	I understand the difference between formative and summative assessments	I regularly provide feedback to students when I use formative assessments during instruction.	I often use educational technology to implement formative assessments.	Formative assessments are a good use of instructional time.
	I rarely or never use clickers during instruction.	Formative assessments encourage superficial learning, or rote memory, of content.	I am not aware of the best practices associated with implementing formative assessments.	I let others implement new teaching methods before I try them	I am aware of the best practices for using clickers in class	I am aware that there are different types of formative assessments that I can use	Formative assessments foster a deeper learning of content.	
		I do not know the difference between formative and summative assessments	I don't really know what to do with the results of formative assessments.	I rely on the technology to provide the feedback to students to save time during instruction.	I am confident in my ability to formatively assess students.	I always know the purpose behind implementing formative assessments in my class.		
		I don't use computer-based software assessments during instruction because it takes away from my teaching time.	Formative assessments should be for practice only and not count towards student grades.	I don't know enough about formative assessments to know if I am using them correctly or not	I am a content expert with a good understanding of formative assessments	Formative assessments are useful in any instructional environment		
				I am aware of the best practices associated with implementing formative assessments.				

Factor 2								
-4	-3	-2	-1	0	1	2	3	4
Most Unlike								Most Like
I understand the difference between formative and summative assessments	I am aware of the best practices for using clickers in class	I regularly provide feedback to students when I use formative assessments during instruction.	Formative assessments should be for practice only and not count towards student grades.	I think formative assessments should only be used outside of class so I can maximize my teaching time.	Formative assessments are useful in any instructional environment	I did not know that there were any recommended best practices for clicker use.	I am not aware of the best practices associated with implementing formative assessments.	I don't know enough about formative assessments to know if I am using them correctly or not
I am aware of the best practices associated with implementing formative assessments.	I always know the purpose behind implementing formative assessments in my class.	I often use educational technology to implement formative assessments.	I use the results of formative assessments to give feedback to students.	Formative assessments encourage superficial learning, or rote memory, of content.	Formative assessments should contribute to student's final course grade.	I enjoy using frequent classroom questioning to assess student progress	I am not aware that there are different types of formative assessments	I do not know the difference between formative and summative assessments
	I am a content expert with a good understanding of formative assessments.	I am confident in my ability to formatively assess students.	I let others implement new teaching methods before I try them	I use computer-based software during instruction to implement formative assessments.	Formative assessments are a good use of instructional time.	I am not aware of how educational technology can enhance implementation of formative assessments.	I am a content expert with a very limited understanding of formative assessments.	
		I never plan in class assessments; I do them on the fly when needed.	I don't feel that formative assessments provide useful information.	I rarely or never use clickers during instruction.	Formative assessments foster a deeper learning of content.	I don't really know what to do with the results of formative assessments.		
		Formative assessments don't really belong in medical education.	I am aware that there are different types of formative assessments that I can use	I always use clickers to formatively assess students during class.	I don't use computer-based software assessments during instruction because it takes away from my teaching time.	I enjoy implementing new teaching methods before others have		
				I rely on the technology to provide the feedback to students to save time during instruction.				

Factor 3								
-4	-3	-2	-1	0	1	2	3	4
Most Unlike								Most Like
I do not know the difference between formative and summative assessments	I rely on the technology to provide the feedback to students to save time during instruction.	Formative assessments don't really belong in medical education.	Formative assessments encourage superficial learning, or rote memory, of content.	I am aware of the best practices for using clickers in class	I always use clickers to formatively assess students during class.	I am confident in my ability to formatively assess students.	I often use educational technology to implement formative assessments.	I am a content expert with a good understanding of formative assessments.
Formative assessments should contribute to student's final course grade.	I let others implement new teaching methods before I try them	I am not aware that there are different types of formative assessments	I don't know enough about formative assessments to know if I am using them correctly or not	I did not know that there were any recommended best practices for clicker use.	I am not aware of the best practices associated with implementing formative assessments.	I use computer-based software during instruction to implement formative assessments.	I always know the purpose behind implementing formative assessments in my class.	I understand the difference between formative and summative assessments
	I think formative assessments should only be used outside of class so I can maximize my teaching time.	I never plan in class assessments; I do them on the fly when needed.	I rarely or never use clickers during instruction.	Formative assessments foster a deeper learning of content.	Formative assessments are a good use of instructional time.	I enjoy implementing new teaching methods before others have	I regularly provide feedback to students when I use formative assessments during instruction.	
		I don't use computer-based software assessments during instruction because it takes away from my teaching time.	I am a content expert with a very limited understanding of formative assessments.	I am aware of the best practices associated with implementing formative assessments.	I don't feel that formative assessments provide useful information.	I enjoy using frequent classroom questioning to assess student progress		
		I am not aware of how educational technology can enhance implementation of formative assessments.	I don't really know what to do with the results of formative assessments.	Formative assessments are useful in any instructional environment	Formative assessments should be for practice only and not count towards student grades.	I use the results of formative assessments to give feedback to students.		
				I am aware that there are different types of formative assessments that I can use				

Factor 4								
-4	-3	-2	-1	0	1	2	3	4
Most Unlike								Most Like
Formative assessments don't really belong in medical education.	I don't feel that formative assessments provide useful information.	Formative assessments should contribute to student's final course grade.	Formative assessments should be for practice only and not count towards student grades.	I understand the difference between formative and summative assessments	I am aware of the best practices for using clickers in class	I am not aware of the best practices associated with implementing formative assessments.	Formative assessments foster a deeper learning of content.	I am a content expert with a very limited understanding of formative assessments.
I never plan in class assessments; I do them on the fly when needed.	I think formative assessments should only be used outside of class so I can maximize my teaching time.	I am aware of the best practices associated with implementing formative assessments.	I did not know that there were any recommended best practices for clicker use.	I don't use computer-based software assessments during instruction because it takes away from my teaching time.	I do not know the difference between formative and summative assessments	I don't really know what to do with the results of formative assessments.	I enjoy using frequent classroom questioning to assess student progress	I rarely or never use clickers during instruction.
	I always use clickers to formatively assess students during class.	I often use educational technology to implement formative assessments.	I always know the purpose behind implementing formative assessments in my class.	I am aware that there are different types of formative assessments that I can use	I rely on the technology to provide the feedback to students to save time during instruction.	I use the results of formative assessments to give feedback to students.	Formative assessments are a good use of instructional time.	
		I enjoy implementing new teaching methods before others have	Formative assessments are useful in any instructional environment	I am a content expert with a good understanding of formative assessments.	I don't know enough about formative assessments to know if I am using them correctly or not	I regularly provide feedback to students when I use formative assessments during instruction.		
		Formative assessments encourage superficial learning, or rote memory, of content.	I am confident in my ability to formatively assess students.	I use computer-based software during instruction to implement formative assessments.	I let others implement new teaching methods before I try them	I am not aware that there are different types of formative assessments		
				I am not aware of how educational technology can enhance implementation of formative assessments.				

APPENDIX G

POST-SORT INTERVIEW QUESTIONS

Post-Q Sort Interview Questions

1. Why did you choose the statements for the +4/Most Agree column?

2. Why did you choose the statements for the -4/Most Disagree column?

3. Were there any statements that were difficult for you to sort? Explain why?

4. Are there any statements or perceptions you would like to add?

APPENDIX H

PARTICIPANT CONSENT FORM

ADULT CONSENT FORM

OKLAHOMA STATE UNIVERSITY

PROJECT TITLE: Faculty Perceptions of Formative Assessment and Implementation Practices: A Q Method Study

INVESTIGATORS:

Brandy L. Close, M.Ed.

Oklahoma State University

PURPOSE:

This study will examine how faculty perception of formative assessment contributes to or hinders successful implementation and its correlation to overall student outcomes on high-stakes summative assessments.

PROCEDURES

In this study, you will be asked to perform 3 tasks: 1) complete a Q sort of statements about perception of formative assessment, 2) verbally answer a few questions reflecting on the Q sort process, and 3) complete a demographics and background questionnaire. You may be contacted by the researcher for clarification of your responses if questions arise during data analysis. This process should take approximately 1 hour.

RISKS OF PARTICIPATION:

There are no known risks associated with this project which are greater than those ordinarily encountered in daily life.

AUDIO RECORDING:

The verbal responses to interview questions relating to the Q sort will be audio taped for data analysis purposes. During data analysis, audio recordings will remain in sole possession of the researcher until analysis is complete at which time the audio recordings will be erased.

BENEFITS OF PARTICIPATION:

Your participation in this study will help educational professionals better understand faculty understanding of formative assessment and how to improve the educational process.

CONFIDENTIALITY:

Individual research participants will not be identified in any publication or presentation of research results. The records of this study will be kept private. Any written results will discuss overall findings and will not include information that will identify you. Research records will be stored on a password protected computer in a locked office and only researchers and individuals responsible for research oversight will have access to the records.

CONTACTS:

You may contact any of the researchers at the following addresses and phone numbers, should you desire to discuss your participation in the study and/or request information about the results of the study: Brandy L. Close, M.Ed., Dept. of Medical Education, Oklahoma State University Center for Health Sciences, Tulsa, OK 74137, (918) 561-8473. If you have questions about your rights as a research volunteer, you may contact the IRB Office at 223 Scott Hall, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu

PARTICIPANT RIGHTS:

I understand that my participation is voluntary, that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time, without penalty.

CONSENT DOCUMENTATION:

I have been fully informed about the procedures listed here. I am aware of what I will be asked to do and of the benefits of my participation. I also understand the following statements:

I affirm that I am 18 years of age or older.

Preface the signature lines with the following statement (expand if appropriate):

I have read and fully understand this consent form. I sign it freely and voluntarily. A copy of this form will be given to me. I hereby give permission for my participation in this study.

_____ _____

Signature of Participant Date

I certify that I have personally explained this document before requesting that the participant sign it.

_____ _____

Signature of Researcher Date

VITA

Brandy Close

Candidate for the Degree of

Doctor of Philosophy

Thesis: FACULTY PERCEPTION OF FORMATIVE ASSESSMENT AND IMPLEMENTATION PRACTICES: A Q METHOD STUDY

Major Field: Educational Technology

Biographical:

Education: Completed the requirements for the Bachelor of Science in Exercrise Physiology from Texas Christian University, Fort Worth, Texas in 1996. Completed the requirements for Master of Education from Texas Christian University, Stillwater, Fort Worth, Texas in 2002. Completed requirements for the Doctor of Philosophy in Educational Technology from Oklahoma State University, Stillwater, Oklahoma in May, 2016.

Experience: Director of Curricular Affairs, Instructional Design, and Academic Technologies, 2014-present. Coordinator of Instructional Design, Assessment, and Educational Technology, 2013-2014. Graduate Assistant-NASA Education Projects, 2010-2013. Mathematics and Science Teacher, Texas, Virginia, and Georgia, 1997-2009.

Professional Memberships: Association for Educational Communication and Technology, International Association of Medical Science Educators, American Educational Research Association